THE

ELECTRICAL REVIEW.

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DISTRIBUTION OF POWER BY ALTERNATE CURRENT MOTORS.

MR. ALBION T. SNELL'S paper on this subject, read before the Institution of Electrical Engineers, discusses the various alternate current motors now in the market, and considers how far they lend themselves, with transformers, to a system of distribution for power and light.

The paper really deals with motors which have been designed for alternating currents, but which are not, and never have been, in the market, except as scientific toys. Ordinary direct current motors, with laminated fields and armatures, are in the market, but they are of so small a size that they are scarcely worth discussing.

Another motor involving the transformer principle is discussed, in which the armature and field are laminated. With this exception it is an ordinary motor, as made for continuous currents with the usual commutator and brushes. The field winding is double, having a primary and secondary circuit; the primary is connected to the mains, the secondary to the brushes. This motor was designed by the author of the paper, and an assistant, Mr. Jacobi. It is said to be a self-starting motor with considerable initial torque, but is practicable only in very small sizes. When made of one horse-power its efficiency is only 60 per cent., or less. It is not in the market, and is never likely to be, for the author gives a very formidable list of drawbacks and defects found in this motor.

Motors with condensers and other devices are discussed; but, besides being uncommercial, they have so many obvious difficulties, that we need not refer to them here.

In describing motors having laminated field magnets and armatures of ordinary continuous current type, the author omits to mention the motor of Mr. Rankin Kennedy, which, like the author's motor referred to, involves the transformer principle. There is an advantage in this motor in that it requires neither brushes nor commutator. A description of this machine appears in our issue of May 27th, 1892.

The only motors discussed in the paper and which are in the market, available for the distribution of power by alternating currents, are the ordinary reversed alternator and the multiphase motors. The author dismisses the reversed alternators in a very few words, and states that little progress has been made in their application to general commercial purposes. This may be true, but the same may be said about ordinary continuous current motors; for, with all their perfection, they have not—in this country, at any rate—made much progress in their application to general commercial purposes. Both reversed alternators and ordinary continuous current motors are in use in some isolated cases here and there; but in the case of neither can it be said their application is general.

The reversed alternator is the natural alternating motor;

it is highly efficient and perfectly self-governed; it has certain peculiarities as hitherto constructed, which, when stated without any qualifying explanations, are apparently very grave objections to its use. The chief of these peculiarities is that it will not start with load on; it can be made self-starting by various methods, but not with the load on. That this need not be a fatal drawback is amply proved by the fact that tens of thousands of gas engines were made, sold, and kept at work regularly before they were made self-starting. Even at the present moment few gas engines can start with load on; yet gas engines are considered to be quite satisfactory and practicable motors. Engineers rather remind us of the child crying for the moon; they cannot obtain their ideal motor, and therefore reject the motors at hand, because their use entails some little trouble, which trouble would not, they imagine, exist in their ideal machine.

Even in the case of steam engines, most of them are started with little or no load on; only in the cases of ship propulsion and traction on rails and roads is starting with load on an absolute necessity. Outside of these applications the reversed alternator has a wide field, when the electro-motor comes to be adopted for general commercial purposes.

We know that reversed alternators can not only be made self-starting, but also self-exciting, without any complications, and we are decidedly of the opinion that the reversed alternator will be the motor adopted for the work on the existing alternating current single-phase systems. The chief reasons why they are not now adopted are just the same as in the case of the perfected continuous current motor, and are—firstly, the current is at present too dear to enable electro motors to compete with gas or other engines; secondly, electric current is not to be obtained in many places, while gas is universal. Whenever the demand for electro-motors becomes really pressing, we are quite confident of the ability of our manufacturers to meet it, both on alternating and continuous supplies.

The paper very fully discusses the multiphase motors, diphase and triphase, and gives particulars of the author's own experiments, which are very interesting.

Multiphase motors have a great future before them in the transmission of power to a distance by electricity, when such transmission becomes necessary. Meanwhile we continue to carry our energy stored in coal to the point where it is to be utilised; we use some small portion of the coal to produce the energy we require, and the rest of the coal we dissipate into thick black fogs spread over our large cities.

The electrician fondly hopes at some future time to entirely abolish these fogs by generating the energy at the coal field and carrying it only into the towns in the form of electric current; high pressure must be used for transmission purposes, hence transformers are necessary, and these two considerations will compel the use of alternating currents and alternating motors. Multiphase motors, or motor generators, would meet all the requirements.

The triphase motor seems to be the best arrangement of multiphase machine, and should have some immediate applications in distributing power in mines and steamships, where the absence of commutators and brushes have many advantages.

There are many able men working at the solution of the alternating current motor problems, and just how much has been accomplished, and what has been discovered, is no doubt difficult to ascertain. Mr. Snell's paper, we hope, may be the means of eliciting some information regarding the progress being made at the present moment in the distribution of power by alternating current motors.

The author entirely fails to recognise the difficulties in the way of working triphase or multiphase motors on a common system for lighting as well as power. Until we can split up a single-phase current into multiphase currents without any losses, it seems to us that the multiphase motor stands much less chance of general adoption than the despised synchronous reversed alternator does.

ELECTRIC STATIONS AS INSURANCE RISKS.

The fire hazard of electric lighting, though a well-worn subject, succeeds in cropping up from time to time, and is the theme of many a paper, and the fruit of many a discussion. In this country, however, matters have so far settled down that we now rarely hear of those mishaps formerly attending electric lighting, and the fire offices have little to complain of in the way of, so-called, electrical fires. In America, however, the case is somewhat different. Complaints still reach us of the unsatisfactory—not to say slip-shod—manner in which many of the installations are carried out, and we believe the fire offices have good cause to regard the "light of the future" as anything but an unmixed boon in that country. It would appear, also, that the same experience applies to the generating stations, which have proved during the past few years to be very unremunerative risks; so much so, indeed, that some insurance companies decline to entertain them on any terms, while others charge practically prohibitive rates, or impose conditions unacceptable to the lighting interests. Why the grinding out of electricity should be so hazardous an operation in the States is more or less a mystery, and we have for a long time looked in vain for some statistics dealing with the question.

Mr. Geo. P. Low, of San Francisco, has endeavoured to supply the want by a paper read before the Fire Underwriters' Association of the Pacific, as published in the *Western Electrician* of March 18th last. It is true the results of a canvas by circular of the 180 stations within the jurisdiction of the Association are somewhat disappointing, only 87 having responded, and the greater part of these returned figures only for the year 1892. Still they are interesting, and, in a measure, reassuring.

It is now pretty evident that the high loss ratios is due not to this or that particular system of distribution, nor to any particular device or apparatus employed—in fact, to nothing that may be said to be specially inherent in electricity itself—but to causes appertaining to any factory or works where power is employed, and where the arrangements for such are faulty. During the rush in the early days of electric lighting, any shanty was considered good enough for a generating station, the main thing being to get the current along and the money coming in. Hence it is not surprising to find that of the 87 stations referred to, nearly 50 per cent. are timber

buildings, and several are joint occupancies with other risks, such as planing mills, saw-mills, and flour mills.

As a sample of one of these early ventures, we extract the following:—"The boiler, engine, dynamos, oil house, coal pile and everything were huddled together in this one enclosure as cheaply as it was possible to do it. The machinery was stopped at midnight; no watchman was engaged; the building was in the rear, so that it could not be seen from the street, and we have never been able to determine whether, in raking out the fire before shutting down, some coals were left on the floor which was saturated with grease, or whether some tramp came in to lodge; but we do know that on the morning of April 24th, 1880, the fire took place."

The estimated value of buildings and plant of the 87 stations referred to amounted to about £832,857, upon which insurances were effected to the extent of £175,494, at an average rate of nearly 2 per cent., and it is satisfactory to know that during last year these particular stations suffered damage by fire to the extent only of £690. The causes are attributed to hot bearings, defective fire-box, and "general fires," by which we presume is meant neighbouring fires. Unfortunately no information is forthcoming of the experiences of the remaining 93 stations.

Turning to home, the contrast is striking. Our public supply companies find it to their advantage to erect most substantial structures for their generating stations, built to stand for all time, and in which they provide against fire by the simple expedient of excluding from their boiler houses and engine rooms anything of a combustible nature. Hence there is no difficulty in effecting insurance to any extent required, and at very moderate rates.

In the States improvements are being effected in this respect. Stations are now being erected that, from the fire point of view, leave little to be desired, and the day, let us hope, is not far off when the wooden shanty with its greasy floor will have become a thing of the past.

DEVELOPMENT OF THE INCANDESCENT LAMP.

The lecture delivered by Mr. Weston before the St. Louis Electric Light Convention forms very interesting general reading, especially to those who have closely followed the development of electric lighting from its birth. Mr. Weston's name is deservedly famous throughout the world as one who has materially aided in the advancement of both arc and incandescent lighting, and he is therefore qualified to speak with not a little authority on the subject. And each remark he makes, or almost every one, has a very sound and genuine ring about it. To be critical, the discourse is a little disjointed, and some of the subjects dealt with are, perhaps, rather unduly elaborated, whilst others, equally important, are wholly omitted; but this arises largely from the wide nature of the subject handled.

In the opening part, when referring to the opinions that were antagonistic to the possibility of practical electric lighting, the lecturer was under the necessity of being personal, and his strictures are certainly very severe. Although all he says is strictly true, we think he should in justice have referred to Mr. Preece's well-known early conversion from the error of his opinions, and to the convert's subsequent indefatigable support of the light he at first condemned. In the list of difficulties, real and imaginary, which were advanced in early days against the art, a rather notable one is omitted, viz., the doubtful feasibility of commercially constructing a practicable incandescent lamp. On first reading in the daily papers the memorable description of Mr. Edison's lamp, made with a horseshoe conductor of carbonised paper, the main difficulties which presented themselves to one's mind, and we think this applies to many, was, first, the impossibility of keeping the vacua, and second, the extremely delicate manipulation required in the construction. They were feasible enough, no doubt, to construct as scientific toys, but industrially *never*. Although without any foundation, the objections seemed very real at the time. In recalling old objections and reviewing the history of the art, it is interesting to note how many difficulties formerly unduly magnified, have, in process of time, been minimised into insignificance, whilst others which were almost unheeded, have proved giants in comparison and have needed much thought and experiment to deal with. As an instance of the former, we may cite the admirable retention of the vacua in lamp bulbs, and of the latter, the unfortunate blackening phenomenon.

In discussing descriptions of filaments, Mr. Weston considers Mr. Townley's classification too restricted (see our issue for March 7th), but if the latter gentleman's list is not sufficiently comprehensive, we regard the one proposed as too broad. This reads as follows:—"First, carbons made from cellulose, the physical characteristics of which have been modified by some process of manufacture which has more or less broken up the fibres or re-arranged them, and bound them together mechanically. Under this head, I would include paper, cotton, or linen thread or braid, and, as being closely allied, I would also include silk thread or braid. Second, carbons made from the previously-named manufactured products, but which have subsequently been subjected to some chemical process, and thus form a more or less perfect mechanical and chemical union between the interlaced fibres. Third, carbons made from wood by simply splitting the wood in a direction as nearly coincident with the direction of the fibres as possible. Fourth, carbons made from any of those already mentioned, but for reasons which I shall presently mention, exposed to the flashing process or hydro-carbon treatment. Fifth, carbons made from a perfectly homogeneous base, about which I shall have more to say later on." We should be surprised, for instance, to hear of any factory, even in early days, having turned out lamps containing filaments under Class 1, and if lamps with such filaments have never been on the market, and are never likely to be, we fail to see why the class should have been enumerated. It would have been better to have divided up Class 4. For the same reason Class 2 might almost have been omitted. All the remarks made, however, on the characteristics of the different filaments are very sound and correct. Mr. Weston is a firm believer in the superiority of a homogeneous carbon over all others, and there is no doubt he here stands on very firm ground, if on no more solid foundation. He was practically the first to work on it, and knows well all its features. We take exception, or, rather, would suggest it as still a moot point, whether his view is *quite* correct that a

homogeneous carbon "requires no treatment to make it better adapted for use in an incandescent lamp." We are not so convinced that it does "perfectly fulfil all the requirements of the art as it exists to-day." With respect to durability we entirely agree, but we do not hold this desirable property as constituting the ultimatum of an incandescent lamp. We regard the quality of comparative freedom from blackening of the bulbs as quite as essential a point as durability; and, as far as our experience goes, we do not find that lamps made from homogeneous carbon, pure and simple, are by any means immaculate in this respect—not equal, in fact, to certain other lamps with which we are acquainted, made on somewhat different lines.

The remarks on the subject of the flashing process are decidedly interesting. Several scientific and other pioneers seem to have hit upon the process in an entirely independent manner—Marcel Deprez, Sawyer and Man, Weston and Lane-Fox, to wit. As to legal rights, however, we should have been glad if Mr. Weston had explained a little how he hoped to have maintained his claims to priority over Sawyer and Man, with his admittedly anterior application for a patent for the process.

From the few allusions that were made to the new stopper lamp, it would appear that Mr. Weston does not seem to be profoundly impressed with its novelty or superiority.

The Insulation Resistance of Private House Circuits.

An examination of the various standards adopted for the insulation resistance of private house circuits shows a very wide divergence of opinion on the subject; this, although generally known, has not been much remarked on. Mr. Tremlett Carter, in an article in a London contemporary draws attention to the various rules which have hitherto been laid down, the values for insulation varying in the ratio of ·87 (Institution of Electrical Engineers), to 75 (London Electric Supply Corporation, *maximum*). There is much more, we believe, as regards good insulation, in careful work than in quality of material, *i.e.*, a careless workman cannot obtain high insulation if he makes bad joints, &c., in good wire, whilst on the other hand a good workman can obtain a fairly good result with low (not *bad*) quality wire. As a matter of fact the total cost of an installation is so little affected by the extra cost between low and high quality wire, that there is little excuse for using the former, although the low prices which some firms tender at renders it a great temptation for them to cut down prices in all directions in order to enable them to make a profit of any kind. We can hardly agree with Mr. Carter's remarks in the article in question that "rubbish is a trifle easier to handle," the reverse we should say is the case. There is a good deal of truth in the statement that "The highly respectable firms tender high prices, not because it costs them so much more to put in good material, but because they have a monopoly of first-class workmanship and can command their price." That the standards of insulation should differ so much is, perhaps, surprising, the higher value, viz., 75, would not be insisted upon if it could not be worked to, and we have never found any decided objection raised to its use in a specification; there seems no reason therefore why a lower value should be admitted.

A Sensitive Galvanometer.

A modified astatic galvanometer is described by H. E. J. G. Du Bois and H. Rubens in a joint paper contributed to the *Annalen der Physik und Chemie* (1893, No. 2, pages 236—251). From the seven experimental trials to which they have subjected this instrument they believe it to be unusually sensitive. Figures are given showing the elevation and plan of the instrument, and its value is copiously illustrated by tables of experimental results. They take the nomenclature and classification which was recommended by Ayrton, Mather, and Sumpner, [*vide Phil. Mag.* (5), Vol. xxx., pages 58—95], in their paper on "Galvanometers," which was read before the Physical Society on January 17th, 1890. With this classification current sensitiveness s_a, is the deflection in scale divisions per micro-ampère, distance of scale being 2,000 divisions and the full period of swing being 10 seconds. The ballistic sensitiveness s_b, is the deflection in scale divisions per micro-coulomb, distance of scale being 2,000 divisions. The period of swing being ten seconds with light suspensions, the value of $s_a = 800$, whilst according to Professor Ayrton's table the highest value of $s_a = 413$. Experiments were also undertaken, the results of which show the ballistic sensitiveness: the results are appended in tables. The paper is dated from the Physical Institute of the University of Berlin.

Inglorious Photometry.

Ingenious as is the opera-glass photometer of Sir David Salomons, it has not yet impressed those who talk about these things as a suitable instrument for comparing intensities of illuminants. Its lack of popularity does not arise from any defect in itself, but is owing to the inequality of the two eyes of individuals. There are objections to taking alternate measurements with either eye, chiefly because this would necessitate a hopeless disturbance of the standard candle in its candle standard. Here then is a grand chance for a candle which would consistently burn simultaneously at both ends; or some Aladdinic arrangement for exchanging the lamps at the right moment. A contemporary suggests, as a way out of the difficulty, that the observer, after taking sights one way, should read the other while standing upon his head. This might be very well in practice but we are afraid the whole theory of photometrics would be insulted by such a device. We tried it ourselves, and found that the power-candle of the lamp now varied *directly* instead of *inversely* as the distance of the observer from the square. It happened to be a metropolitan square, which made it much worse for the gymnastics.

Electrolysing the rare Earths.

From some recent researches by Dr. Gerhard Krüss, it appears that a suitable method for working up the metals of the rare earths is afforded by the electrolysis of solutions of these earths. A solution of an earthy chloride behaves on electrolysis just like a solution of the hydroxide in dilute hydrochloric acid; chlorine and hydrogen are evolved at the electrodes, the solution of the chloride losing more hydrochloric acid and allowing hydroxide to deposit in an increasing quantity in proportion to the decrease of the solvent. In this manner varying quantities of earths can be eliminated from the chloride solutions of mixtures of the rare earths, when it is to be expected that those bases which prove weakest in contact with hydrochloric acid are first thrown down as hydroxide as soon as a part of the hydrochlorides are decomposed by electrolysis. The stronger bases remain still in solution as mere stable chlorides. In order to withdraw the hydrochloric acid from a chloride solution of rare earths as uniformly as possible in all parts of the liquid, electrodes with large surfaces, were found most desirable by Dr. Karl Hofmann, who carried out Dr. Krüss's investigation. From the results obtained with yttria, there seems every reason for believing that an electrolytic method of some commercial importance will soon be elaborated.

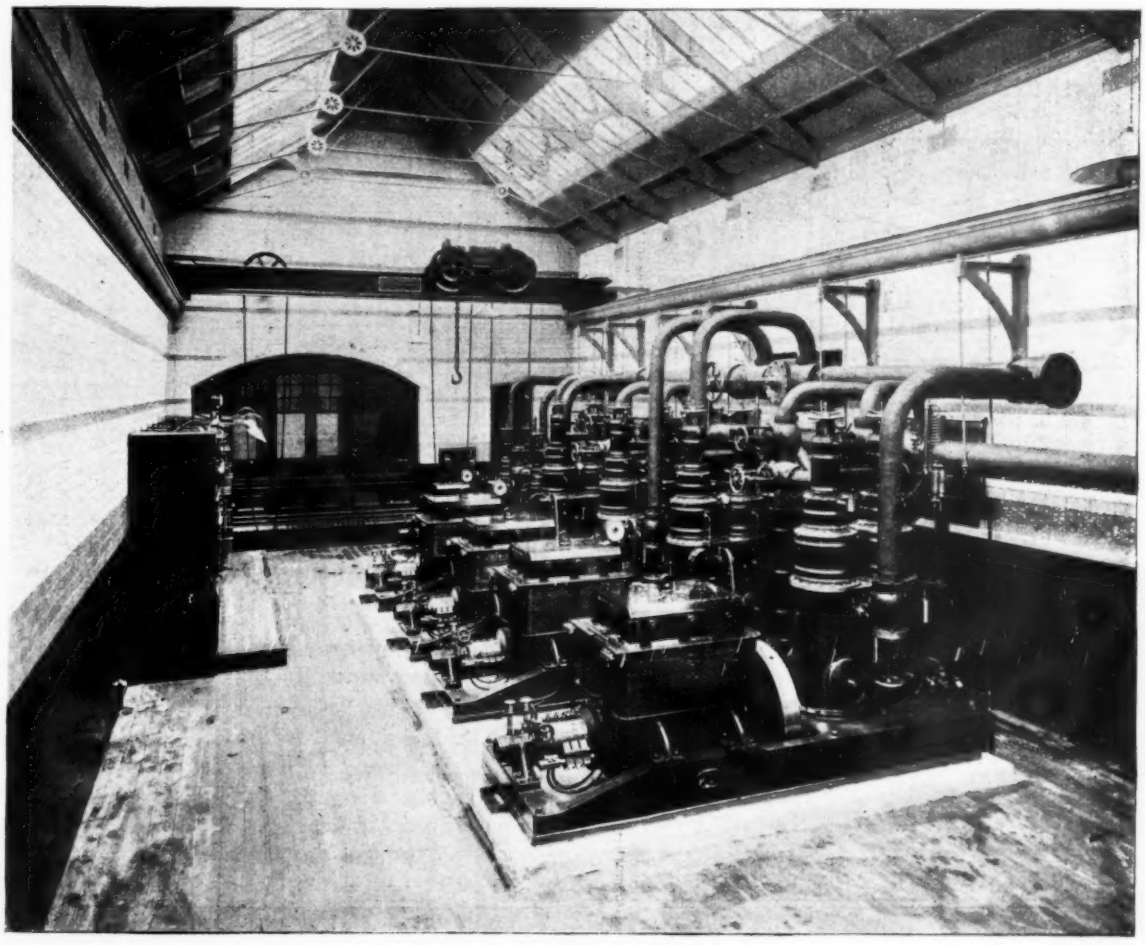
CENTRAL ELECTRIC LIGHT STATIONS.

No. 8.—Dundee Corporation Supply.

The purely electrical machinery of a supply station is becoming more and more of a fixed pattern. This is reasonable enough, for, apart from the survival of the fittest, local authorities are building most of the new stations, and in the exercise of their corporate caution, they are more disposed to copy existing examples than to take the responsibility of new departures.

There is cause for satisfaction in such a state of things, for the general use of a common system is likely to result in attention being bestowed upon what are now neglected factors in central station economy.

The Dundee station is representative of what corporations are now doing. The electrical work appears to be sound, and much care has been bestowed upon what is called the engineering part of a central station.



Interior of the Dundee Station.

The system adopted is the three-wire, and in some respects is similar to that used by the Westminster Electric Supply Corporation.

There are six dynamo machines by Siemens Bros., all shunt wound, fitted with special resistances. Four are designed to give 350 ampères and 250 volts at 360 revolutions, and the remaining two give each 310 ampères, and 140 volts, running at 450 revolutions. The dynamos are coupled to Willans engines of the H H and I I type. The resistances drop the volts from 250 to 210, and from 140 to 105 respectively on the two sizes of the machines.

There are three Lancashire boilers, 24 feet long and 7 feet in diameter. The working pressure is 160 lbs. It will be seen from the plan of the station that the main steam pipe is in the form of a ring; it is so arranged that any section of the pipe can be cut off without interfering with the supply of steam to any engine.

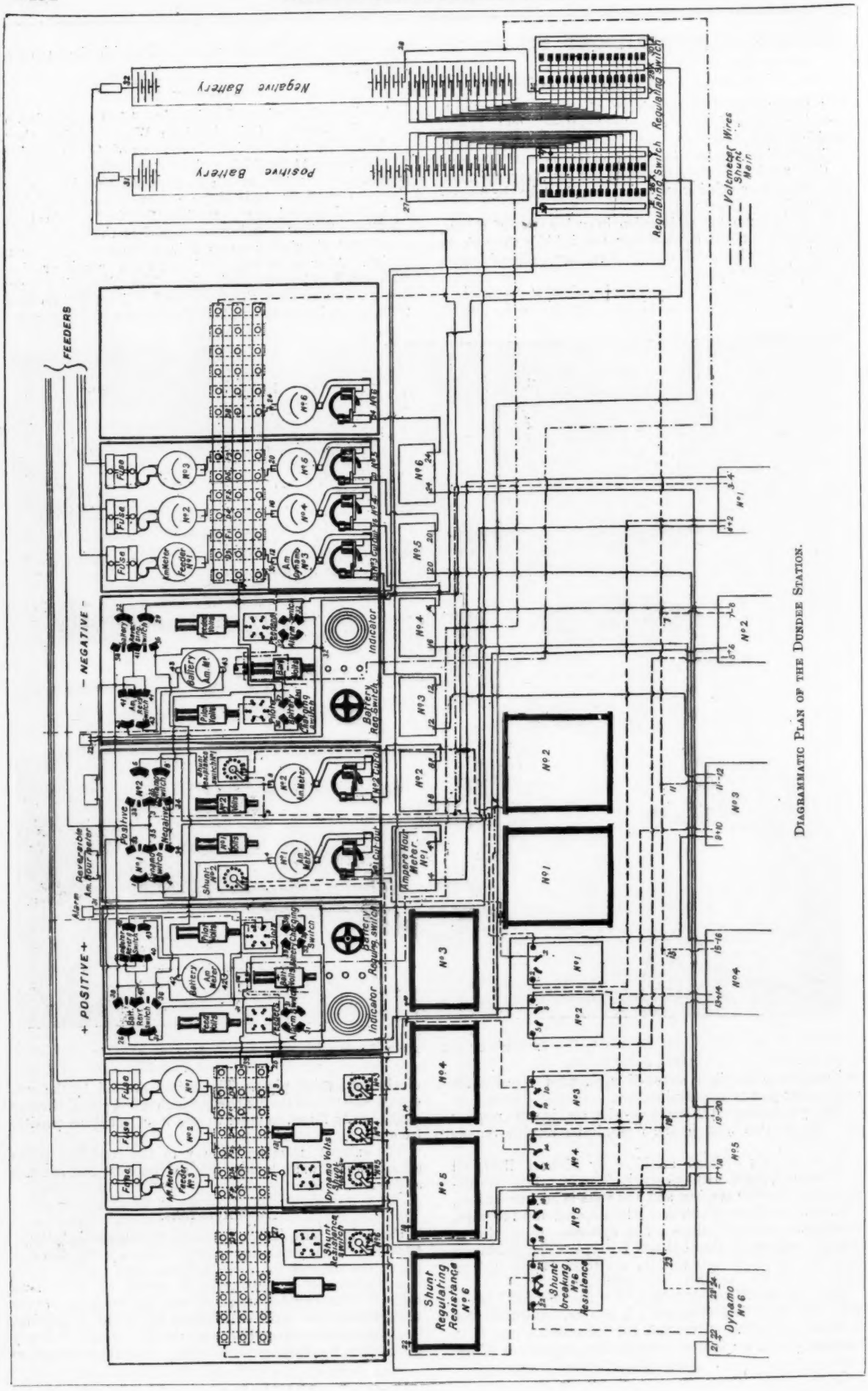
Air Condenser.

An air condenser is used which gives 4,500 square feet of condensing surface. It is placed on Warren girders above the boiler house; it consists of four rows of 4-inch cast-iron ∩-pipes, each 11 feet high. The four rows are connected in parallel to the exhaust main; there are 48 pipes in each row. Each row of pipes stands above a wrought-iron tank about 12 inches deep, and somewhat wider than the ∩. The tanks are filled with water, and are connected to the suction of a centrifugal circulating pump driven from the air pump engine. Above each row of pipes runs a trough provided with small poles over each pipe. The circulating pump draws the water from the tanks and delivers it into these troughs, causing a continual flow of water over the outer surface of the condensing pipes. The boilers are fed by the condensed water from the air pump, which is first passed through a set of cloth filters, in order to free it as much as possible from oil.

The exhaust steam on its way to the condenser passes through a feed water heater, so as to economise heat as much as possible.

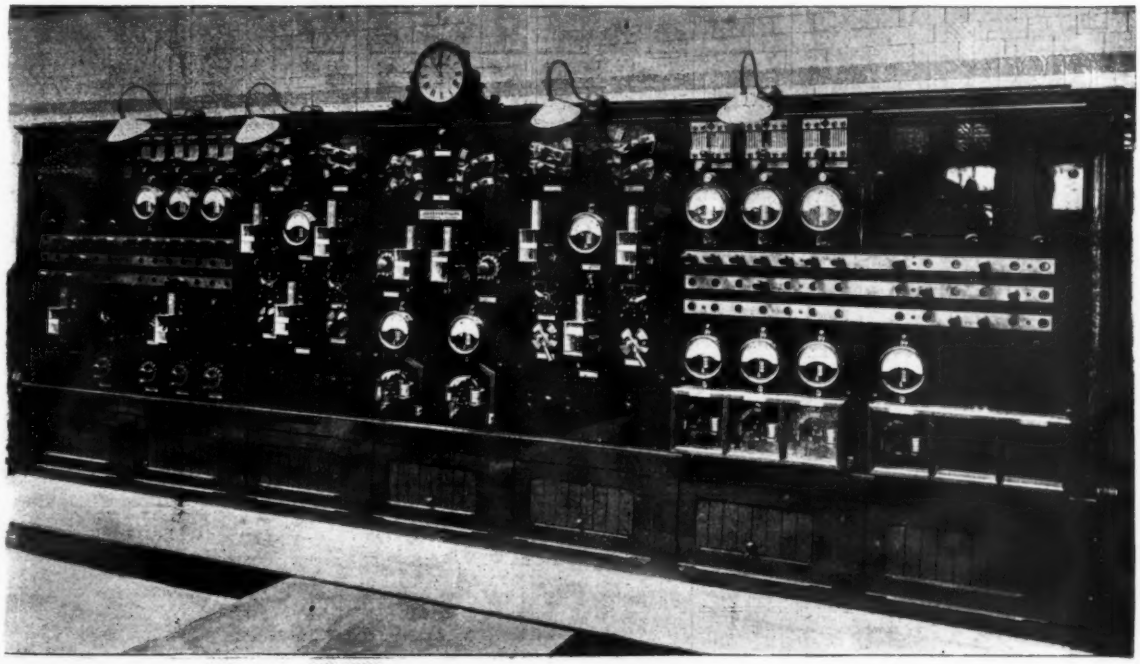
Accumulators.

Forty-eight cells, E.P.S. K 46 type, form the main battery 12 cells form the regulating battery. The capacity is an output of 100 ampères for seven hours, or 350 for one hour. The regulation of these batteries is carried out in a novel manner. The switches are placed near the batteries, and are worked from the main switchboard by means of gearing. This arrangement saves, of course, the employment of heavy cables from the switches to the cells. It would be as well to



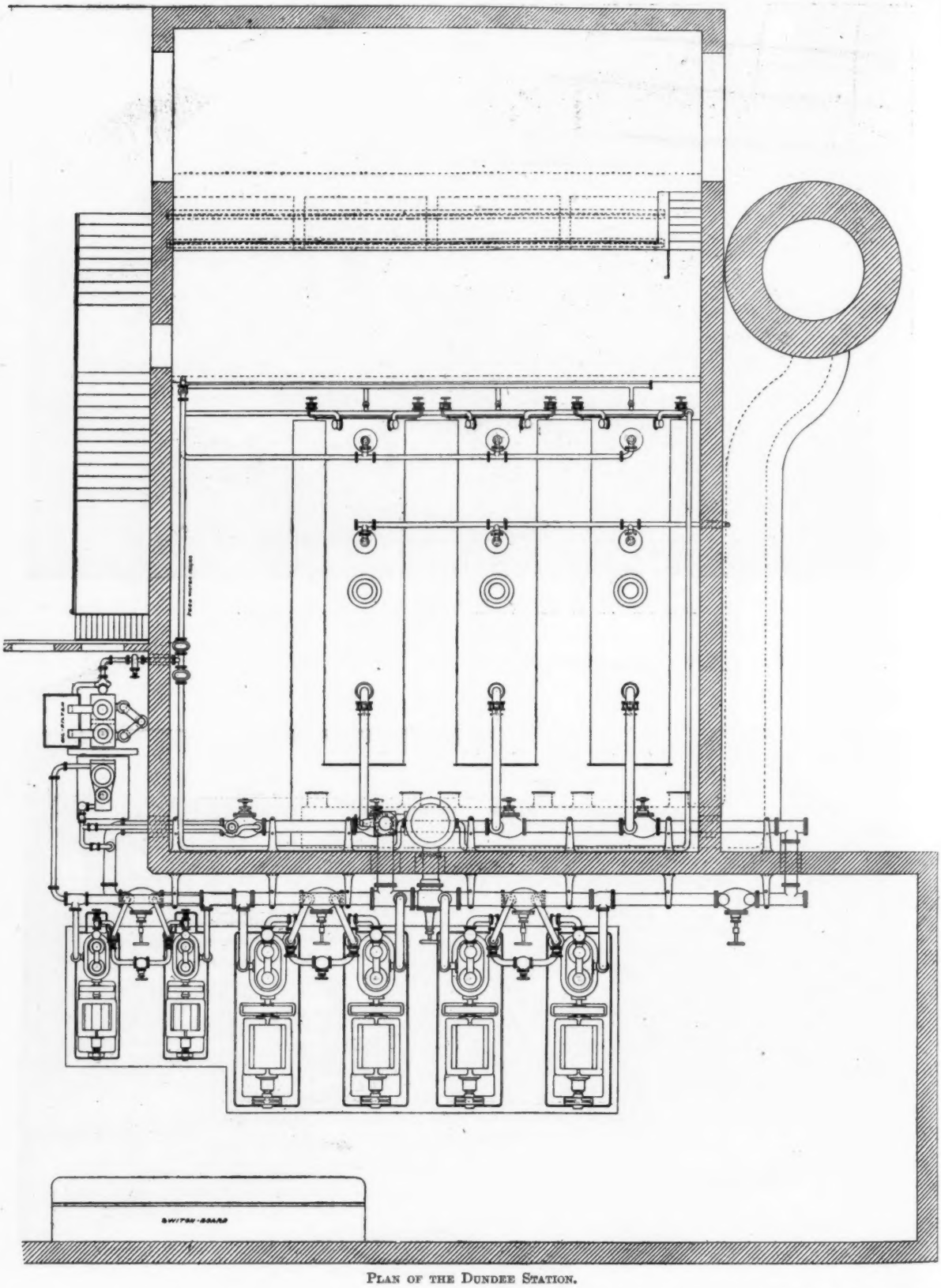
DIAGRAMMATIC PLAN OF THE DUNDEE STATION.

EXTERIOR VIEW OF THE DUNDEE STATION SHOWING AIR CONDENSER.



DUNDEE STATION SWITCHBOARD.

mention here that only the two smaller machines are on the three-wire system pure and simple; as the load comes on the larger machines are put on, and the smaller ones serve to balance.



Plan of the Dundee Station.

Method of Regulating.

The usual method of regulating the E.M.F. of secondary batteries when charging or discharging, or when charging in parallel with the lamp mains, consists in using two multiple contact switches, the separate contacts of which are respectively connected to the end terminal of the battery, and to the connecting bars between cell and cell; the number of cells thus having a double connection, one to the switches and the other to the remainder of the battery, being usually about twelve.

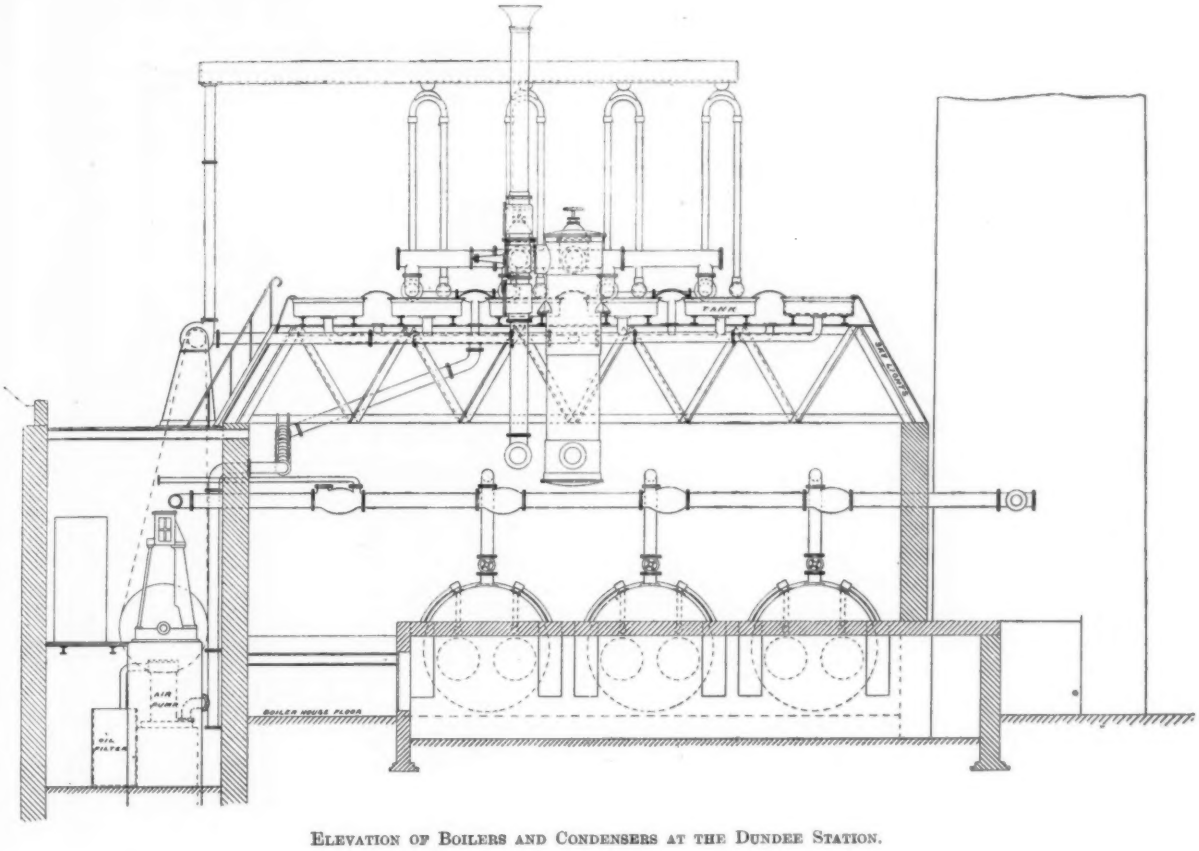
One of the two multiple contact switches has its central

contact connected to the dynamo main, and the other switch has its central contact connected to the lamp main.

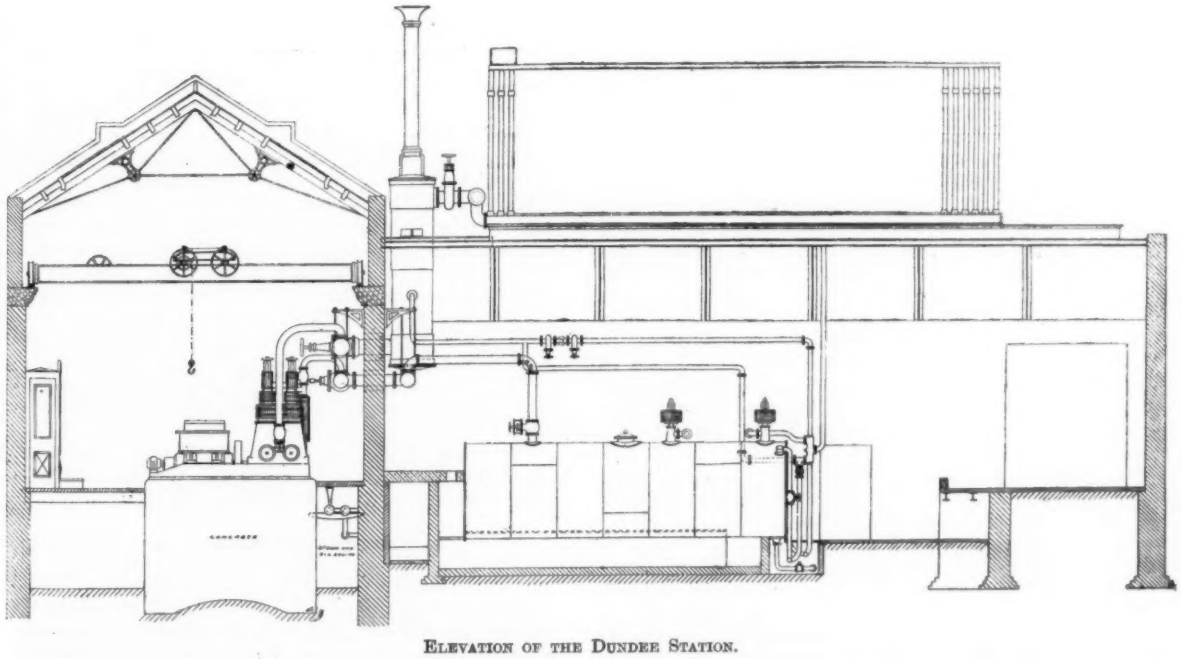
This arrangement enables the E.M.F. on the lamps to be varied without altering that of the dynamo, by so placing the brushes of the switches that the current from the dynamo has to pass through a certain number of the regulating cells before passing on to the lamps.

This arrangement has several serious drawbacks. First, the whole current generated by the dynamo has to pass through the regulating cells that are in the lamp circuit, dividing at the cell to which the lamp circuit brush is connected, part going from that point through the remainder of regulating cells to the main battery, and part going to the lamp circuit.

Secondly, the E.M.F. that can be used for charging the main battery, *i.e.*, the cells beyond the regulating cells, can never be greater than the E.M.F. required for the lamp circuit. In cases where the E.M.F. required for the lamp circuit varies considerably, as in central stations having a very low day load, it is therefore imperative to have a large



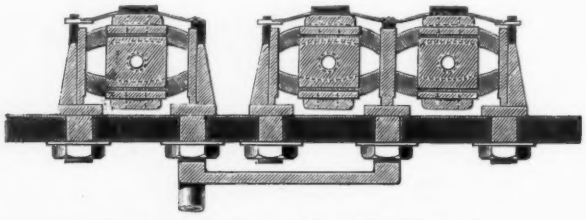
Elevation of Boilers and Condensers at the Dundee Station.



Elevation of the Dundee Station.

number of regulating cells. For example, if there is a loss of 15 volts in the feeders at maximum demand on a 100 volt supply, the total number of cells must be 60. On the other hand the day load being light, the loss in volts will not be more than two, and as each cell requires an E.M.F. of about 2·4 volts, the maximum number of cells that can be charged in parallel with the lamp circuit will be $\frac{102}{2{\cdot}4} = 43$, so that 17 of the 60 cells will have to be connected to the regulating switches.

Thirdly, with the usual arrangement of regulating switches the end regulating cells are always much overworked, as it is impossible to alter the position of the brushes without at the same time altering the E.M.F. of the lamp circuit or of the dynamo.



Battery Regulating Switch—End Elevation.

These objections are avoided by disconnecting the regulating cells entirely from the main battery, and connecting them up in series in the usual way, so as to form a small separate battery.

Three multiple contact switches are provided, each having one contact more than the total number of cells in this small battery. These contacts are connected to the terminals of the cells, the extra contact being connected to the terminal of the main battery.

The contacts of the three switches are thus all in electrical connection, contact No. 1 of switch No. 1 being metallically connected to contact No. 1 of switches Nos. 2 and 3. The centre contacts of the three switches are connected respectively to one dynamo main to the corresponding terminal of the main battery and to the corresponding omnibus bar or lamp main. If now all three switch brushes are placed on the same contact, say No. 1, no current will pass through the regulating cells, the only paths open to it being from No. 1 contact on the dynamo switch to No. 1 on the battery switch and thence through the brush of that switch to the main battery and also to contact No. 1 of the lamp switch and through the brush of that switch to lamp circuit, the lamp circuit and main battery being thus in parallel.

If the lamp switch is now turned to contact No. 2, the current from the dynamo will still have two paths open to it, the first, as before, direct to the main battery, but it will have to go through the regulating cell, No. 1, to reach contact No. 2 on the lamp switch and thence through the brush of that switch to the lamp circuit.

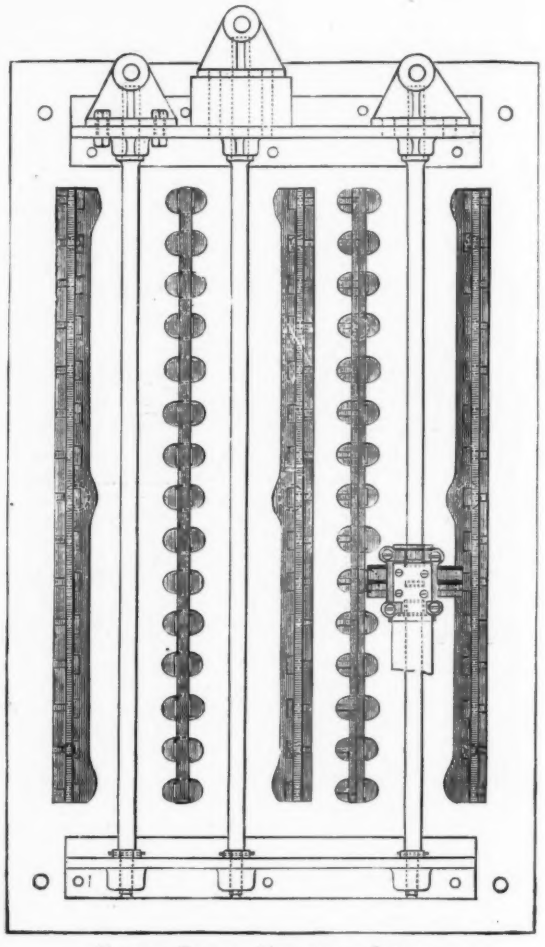
Thus any, or all, of the regulating cells can be put in in series with either the lamps or the main battery.

A further advantage is, that the regulating cells may be used either way, that is, they may, by varying the positions of the brushes, be so connected as either to reduce or to increase the dynamo E.M.F., whether in the lamp or in the main battery circuit or both.

If all three switches are moved together there will be no alteration in the E.M.F. of the two circuits, but different regulating cells will be brought into use.

This is of importance, as it allows of a fair distribution of the charge to the regulating cells, the fully-charged ones being cut out and others substituted, without in any way affecting either the lamp or the main battery current.

The battery switch shown in the drawings consists of three long bar contacts and two rows in between them of insulated contacts, these insulated contacts being connected together, then they are connected to their respective numbers on the regulating batteries. The travelling brushes shown in the end elevation and in plan, connect from the long bar contacts to the insulated ones. If all three brushes are in a line no regulating cells are in the circuit, as the current coming in at the centre bar of the contact would divide and part pass to the lamp mains and part to the main battery through their respective brushes, but if any brush is out of line with the others the regulating cell or cells will be in circuit.



Plan of Battery Regulating Switch.

There is little to be said about the means of distribution; three heavy feeders run out from the station to convenient points where they join on to the distribution network.

The switchboard consists of seven large enamelled slate slabs mounted in a wrought-iron and beaded frame, with a panelled framing underneath, the whole being surmounted by a clock. The left hand boards are arranged for the positive connections, &c., the right hand side being entirely for negative connections, while the middle boards are common for the two lower potential machines. It is made by Messrs. Johnson & Phillips.

The fuses are all of the duplex type with two plugs, to allow of quick change over should a fuse for any reason get blown.

The whole of the station has been designed and carried out under the supervision of Messrs. Urquhart and Small, who are to be congratulated on the successful results.

Coast Communication.—The Royal Commission to inquire into the best possible means of electrical communication between lightships, lighthouses, and the shore at various points on the British coast will commence a second series of visits to the most dangerous parts of the coast on July 10th. The exact route has not yet been settled, but it is understood that it will embrace the north and west coasts of Scotland and England.

THE WATERHOUSE ARC LAMP.

A company has been formed for the manufacture in this country of arc lamps under the Waterhouse patents, and premises have been taken and fitted up for the purpose at No. 67, Southwark Bridge Road.

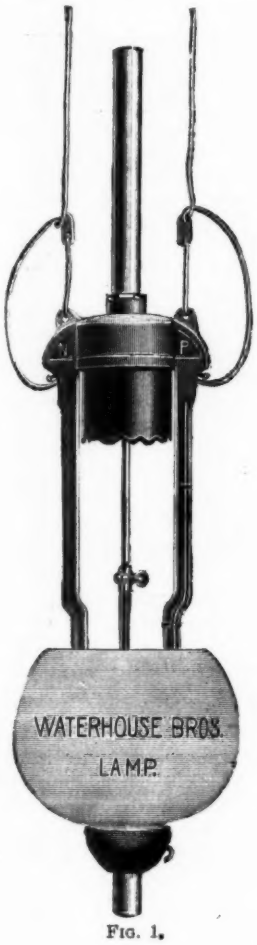


Fig. 1.

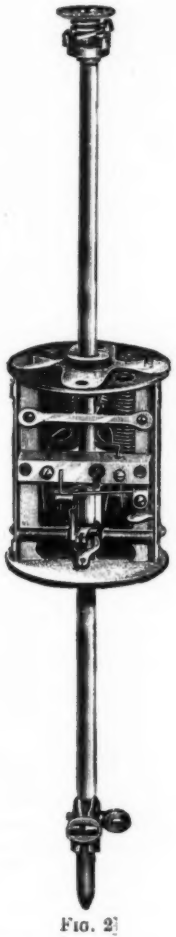


Fig. 2.

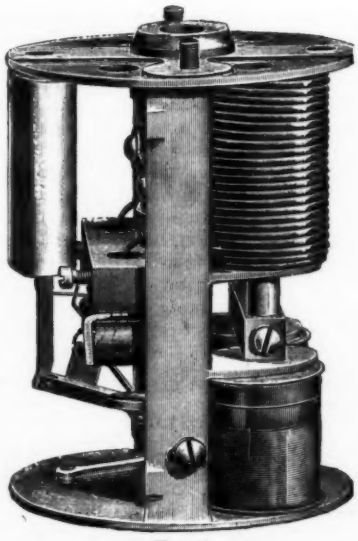


Fig. 3.

The Waterhouse arc lamp (fig. 1) is of strong, solid and compact construction, though weighing only 24 lbs., and appears to be free from the faults in design which incline lamps to become disabled, foul, or out of adjustment. The object of its inventors was to produce a lamp that should be adaptable to either arc or incandescent currents, and suitable for use with any type of dynamo.

The lamp consists simply of two parts; the frame containing the two terminals and lower carbon holder complete in itself, and suitable for any current; and a cage (fig. 2) consisting of a single casting, in which all the works fit with the utmost exactness. These works, with the exception of the cut-outs, are the same for arc and incandescent currents, so that either will fit into the same frame. Fig. 3 shows a cage containing works with the carbon rod out.

All the parts being made interchangeable and fitted compactly into the single casting, it is next to impossible for any portion of the lamp to get displaced or out of repair. There are no insulating washers, the insulations consisting of four pieces of solid cement, as shown shaded black in fig. 4.

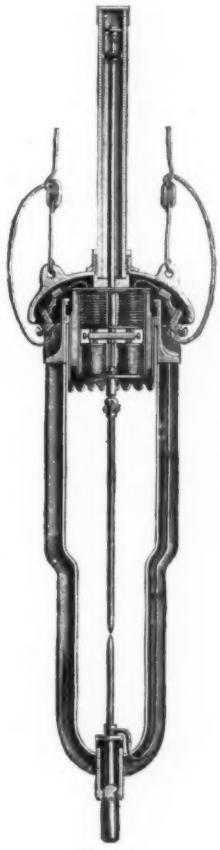


Fig. 4.

The clutch has an atmospheric clamping device which secures a remarkably steady and fine feed, a point that will be specially appreciated when the lamp is used on an incandescent circuit. The durability of the plunger used is so great that it is practically free from wear or deterioration of any kind, and being made of a soft, pliable material, the possibility of sticking or hanging is effectually prevented.

The works being made interchangeable, any alteration in operating the lamps can be made with the minimum of trouble and expense, and in case of accident to any part, only that particular part need be taken out and a new one put in its place.

Special machine tools have been constructed for the purpose of turning out every detail of the lamp with absolute precision, and with the view of producing a large number with as little skilled labour as possible, so that besides being a serviceable and durable lamp, there is every reason why it should be inexpensive.

Burton Electric Lighting.—A Local Government Board inquiry was held at Burton last week, regarding application to borrow monies for certain purposes, one of which is electric lighting.

THE TELEPHONE QUESTION.

When we first criticised the telephonic paper read before the British Association in 1891, it may be remembered that we described the Mann system as a system by which subscribers made known their requirements by talking over a circuit wire, and we stated that the circuit wire system was better known as the Law system. All our remarks were based on a circuit wire system as such, without reference to any details of construction or methods of working. It was contended by the advocates of the so-called Mann system that there were some details in that system which made our generalisation inapplicable, and they especially resented our reference to its relationship to the Law system. For a year and a half we have been allowed to assume that the chief claim for a difference lay in the construction of the circuit wire. We have devoted our attention to that difference, and have shown that the branched circuit wire was a feature of the Law system. It has at length been admitted that we were right, but not until a further feature has been raised by another correspondent upon which to base a further claim. Perhaps when we have disposed of this further claim, some new one may be discovered.

We have referred to the difference in the signal system and the circuit wire system in their primary purpose of making known the wants of a subscriber. In the subsequent steps one subscriber may call another, or the second may be called by the operator. It was early seen that if the calling were done by the subscribers, the operators would be saved some work, and at one time some importance was attached to saving this work.

A correspondent of the *Electrical Engineer* now credits Mr. Mann with originality in throwing the ringing on the subscribers. Our contemporary adopts this claim to originality, and credits Mr. Mann with the application of this general principle to the circuit wire system. Its correspondent is "considerably astonished" at our recent statement, that Mr. Mann did nothing new, and he writes "the addition of the magneto instrument alone to the branched Law system may surely be regarded both as an alteration and a modification," and he thinks that "to endeavour to make out, therefore, that Shaw, the inventor of the Law system, is entitled to all credit, is to deprive one of our most original British telephonists of the praise justly due to him as the first to show how a system which had many drawbacks originally, could be made to surpass the best known systems of the day."

The attempt, upon such a subject, to depart from the main lines of broad principles into minute details has already compelled our contemporary to define a "series Law" and a "branch Law" without putting any new complexion upon the argument. It will now have to define a "magneto-direct-calling-Law," for this detail is, also, a feature of the original Law system. The 1880 circular, from which we have previously quoted, after describing the method of ringing subscribers from the central office, goes on to say:—"Instead of electro-magnet bells the subscribers may, of course, be provided with 'magneto-bell calls,' in which case they can ring up one another."

The modest "of course" of the original inventors of the Law system may be compared with the extravagant claims made for the later adapter, and the completeness with which the Law system was thought out so as to include all variations in construction and working, does not justify the unanimous efforts of Mr. Mann's adherents to dissociate the so-called Mann system from it. Not only is there no originality on the part of Mr. Mann in the use of magnetos for calling subscribers direct, but, as a matter of fact, he adopted magnetos for a different purpose—to drop an indicator over a subscriber's direct line in case of a break-down in the circuit wire. The exchange, according to "The Telephone" (Preece and Maier), p. 309, was furnished with ringing apparatus. The use of magnetos for calling through, was, if we mistake not, an afterthought.

We fear our contemporary has been led to attach undue importance to the ringing feature in consequence of its correspondent describing the exchange ringing as "arduous labour." An inspection of the method described in the work to which we have referred will show how very arduous that labour is. In making a connection with a line the plug passes, and is momentarily in contact with, a ringing strip.

Our contemporary assumed that the branch wires were unknown to the Law Company until "Mann showed them how to do it." It now assumes that the application of the magneto was unknown until Mann showed them how to apply it. The contrary in both respects has now been proved. Not only were these features known, but their suitability respectively under different circumstances was thoroughly understood. Our contemporary assumes that the Law system failed because the exponents of that system were unacquainted with the advantages of direct calling by the application of magnetos. The incorrectness of that assumption is now apparent. The appreciation of the fact that different conditions required different treatment, led the Law Company to adopt that method which was best suited to succeed under the circumstances in which it was applied.

If we were content to adopt our contemporary's method of discussion we should fall in with their argument and maintain that Mr. Mann made no original suggestion or application in regard to the Law system; we should say that the system advocated by the advisers of the New Telephone Company is the Law system pure and simple; this system, Mr. Mann's adherents have been only too ready to admit, has been tried and failed, hence the conclusion of our contemporary's argument is exactly reversed. But there is no advantage whatever in such a method of dealing with so important a question. We have considered main principles, and will continue to do so. Our contemporary's article and its correspondent's letter raises one new question, and one only: "Does the ringing of one subscriber by another make the British Association paper proposals a success?" Experience shows the contrary in this respect, as in the others to which we have referred.

BOILERS AT THE CHELSEA ELECTRICITY SUPPLY STATION.

Our contemporary, *Engineering*, published in its issue of April 7th some tests of steam boilers which it thinks may prove of interest. They were made by Mr. Frank King and Mr. Percy Still, but nothing is said as to whether these gentlemen are accustomed to making boiler tests, or whether there was any special object in doing so.

It appears there are four boilers at the Draycott Place station, two of which are ordinary Babcock boilers, and two are the Mills variety of Babcock boiler, which consists in the addition of a cylindrical furnace, like the furnace of a Lancashire boiler, surrounded by a water shell which is in communication with the mud drum and the steam drum. The water tubes of the Mills boiler are fewer than in the Babcock, but the grate area is the same, and the total heating surface is 1,900 feet against 2,020 in the Babcock boilers. All four boilers are worked together, but the tests were carried out on separate evenings. We have always considered that the Mills furnace, added to the Babcock boiler, gives that which was wanting to make the Babcock boiler more suitable for English fuels in respect to better combustion and smoke prevention, but if these tests are to be relied upon as expressing facts we must have been woefully mistaken. Here are the figures. For the Mills boilers 9·92 pounds of water evaporated, from and at 212°, per pound of coal, or 10·13 per pound of combustible. For the Babcock boiler 12·68 pounds of water evaporated per pound of coal and 13·49 (!!!) per pound of combustible, also from and at 212° Fah.

Fortunately our contemporary does not ask us to believe these figures. We are not disposed to attach too much weight even to the Mills record, but we decline altogether to accept that of the Babcock, not because it is the Babcock, but because we would not believe this of any boiler. It is contrary to all experience. Be it observed, the test was only of 6 hours' duration in either case, and no particulars are vouchsafed as to how the fires were regulated, in each case, with regard to the commencement and termination of the tests.

We are therefore not surprised to find the Mills Sectional Boiler Company writing to *Engineering* and asking that the

tests should be repeated by some independent engineer. An efficiency of 83 per cent. they regard as unprecedented, and they would like to know, very naturally, how it is done. They also think that the Chelsea company should not be permitted to keep so good a thing to themselves. This, of course, "is writ sarkastic," and we would join in here, for the sake of our failing coalfields.

The paper is illustrated by a pair of diagrams containing each six "curves" of pressure, temperatures, draught, water, and coal consumption, said "curves" being lines of more or less crookedness, and of the differential dot variety. We are not told what description of feed heater was employed, nor how it was that the Mills feed was twice allowed to drop to 80° and near to 80°, nor is any explanation vouchsafed of the enormous amount of coal piled into the Mills furnaces at the commencement of the test. It looks as though these furnaces were nearly burned out, whereas those of the other boilers were charged, before the testing began.

The best we can say of the records is that they are powerful illustrations of the dangers accompanying short tests of steam boilers; but we would conclude with the remark that, though the water entering the boilers was measured, no measure seems to have been taken of that which left them, either as priming or through badly leaking blow-off cocks. It would not be a bad move for some genius to sell printed papers for reporting tests. Headings such as "Percentage of leakage at blow-off cock," would serve as reminders and as aids against the publication of such questionable figures, some of which are carried out to the second place in decimals.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

NOTES ON THE INFLUENCE OF ELECTRICITY IN TANNING OPERATIONS. By CONRAD K. FALKENSTEIN, Associate.

It has been known for the last 30 years that the application of an electric current to hides in process of tanning exerts a beneficial effect, increasing the rapidity with which the gelatinous material of the pelt combines with the tannin in the liquors to form leather. Before going further, it may be well to briefly sketch out what occurs when hides are tanned. Ox hide consists roughly of three layers, as follows:—

(*a*) The *epidermis*, consisting of an outer layer, which is constantly being shed, and an inner layer, from which the material of the outer layer is supplied.

(*b*) The *pars papillaris*, of close fibre, in and below which are situated the hair sheaths, fat and sweat glands, and the muscles which erect the hair; the upper coat of this layer forms the "grain" of leather.

(*c*) The *pars reticularis* or corium, a network of fibres, which forms the greater part of the section; this is densest near the layer (*b*), the bundles of fibre becoming more open towards the flesh side. When the hide is taken off the animal the exterior of this layer is covered with flesh, fat, and tissue.

The first thing to be done is to wash the hide free from all blood, salt, &c., or, if sun dried or cured, to thoroughly wash and soften it (this is sometimes assisted by mechanical means); when clean and soft it is treated with solutions of lime of gradually increasing strength, which have the effect of swelling up the hide and splitting up, or commencing to dissolve the fibres. This action takes place most vigorously at the two surfaces; on the grain side it dissolves away the outer cells or epidermis, and the hair *papilla* or knob of corium, which holds and supplies nourishment to the hair, thus allowing it to be easily scraped off by the blunt unhairing knife; on the flesh side it plumps up the *pars reticularis*, causing it to be easily distinguished (by its firmness) by the flesher from the loose membrane and fatty matter which is to be removed. When the hair and flesh are removed, the hides are washed and worked over on the grain side with a stone or blunt knife to force out the lime solution and the remains of hair, epidermis, &c., which are left in the hair cavities after unhairing; after another washing, the hides are ready for tanning.

Now, the hide material or gelatine to be tanned consists of bundles of fibre, each bundle being made up of a refractory base, surrounded by gelatinous, tannable fibres, the axes of which lie generally at right angles to the surfaces of the hide. After liming, the fibres are in a swelled condition, both acids and alkalies (with exceptions) having this property of distending the hide and causing it to absorb water. The action of the tannic acid is to displace the water, and while converting the gelatinous fibres into leather, to maintain the plumpness by an acid reaction after the lime has been neutralised. Other methods are employed for unhairing on the Continent and elsewhere, such as sweating or partial putrefaction, use of sodium sulphide, &c., in which this plumpness has to be produced by the use of sulphuric, acetic, or other acids, or by liquors which contain acetic, lactic acids, &c., through natural fermentation.

The hides are then treated with solutions of tannic acid of gradually increasing strength, until they show a uniform brown colour in a freshly cut section (lighter or darker according to the tanning materials employed), and have the necessary firmness and weight. Care must be taken as to the rate at which the tannic acid solution is increased in strength, for if, after the tannage is fairly commenced, and the lime neutralised, the hides be not fed with stronger and stronger liquors, they lose their firmness, and are said to "go back," after which a species of putrefaction is set up in the interior untanned portion of the hide which causes adjacent bundles of fibre to unite, thus destroying the open fibrous structure of the hide, and practically stopping diffusion; this result may also be produced by using too strong liquors at first, which bind up the pores and prevent liquor from reaching to the interior.

For dressing leather somewhat different methods are followed, but the same precautions must be taken in working the liquors as just described.

The above is the process to be gone through, the functions of the electric current being—

1. To increase the rate at which liquor diffuses itself through the hide, by endosmose effects.
2. To increase the chemical activity of the reaction by molecular vibration.

Many methods of applying the current have been proposed, some depending upon the action of the gases evolved at the electrodes, and others upon the endosmose and molecular effects of the current on the hides and liquor. M. Gaulard patented a process in 1883, making use of the first method, the hides being suspended in a pit, from the perforated false bottom of which, is sent, first, a stream of hydrogen from the cathode; after eight days the current is reversed, and the hides subjected to the action of a stream of oxygen until they were tanned. The other method, which has been employed by Gaulard, Landin and Abom, De Meritens, and others, is to use a pit with electrodes on opposite sides, and pass the current through the liquor and suspended hides at right angles to their surfaces. When the hides are struck through, they are transferred to the layer pits, where they are put in alternate layers with ground bark, &c., liquor being run in either before of afterwards.

The current is now applied by electrodes, placed one underneath and one on top of the pile, the positive pole generally at the bottom. This laying away is repeated until the hides are tanned. By thus applying electricity to the ordinary methods of the tannery, the time necessary for tanning heavy sole leather may be reduced from 120 to 45 days, as proved by the practice of Messrs. Landin and Abom in Sweden, and De Meritens at St. Petersburg. Messrs. Landin and Abom use alternating currents.

If now the electrical action be assisted by suitable mechanical agitation of the liquor and movement of the hides, so as to mix the liquor which has passed through the hide with that remaining in the vat, we shall obviously have an increase in the rate at which the tannage proceeds.

Several processes have been devised to combine the effects of the electric current and motion, amongst which may be mentioned those of Messrs. Worms and Balé, L. Groth, and others. Mr. Groth employs a vat, in the centre of which is a rotating or reciprocating (according to the shape of the vat) frame, on which are suspended the hides or skins to be tanned, an electric current being passed from one side of the pit to the other, through the liquor and hides. This process reduces the time necessary to tan a hide to about 28 days.

Messrs. Worms and Balé's system combines the application of an electric current with the use of a rotating drum; the drum is about 11 feet in diameter, and provided with internally projecting pegs; in operation it is nearly half filled with liquor, and the hides being put in (one by one), the drum is closed and rotated; while in motion an electric current is applied by electrodes, so disposed as to fill the liquor with, and hence subject the hides to, a uniform field of endosmotic force. When the drum is in motion, the hides, floating in the body of the liquor, are turned over, and the liquor mixed, the bottom layers being continually brought to the top by the skin friction. Under these conditions, running continuously, hides may be tanned in about 100 hours. It will be seen that the rotating drum contains four variable factors:—

1. The strength and disposition of the electric current.
2. The speed of rotation.
3. The proportional amount of liquor in the drum.
4. The length and number of the projecting pegs.

Thus giving the system considerable flexibility of treatment. It has now been worked on a commercial scale for some years by the British Tanning Company, Limited, in London, by MM. Brion et Dupré, in Paris, and also in America.

Considering the purely electrical and chemical effects on the hides and liquor, the final result has been established by the experiments of Messrs. Rideal and Trotter, Prof. Müntz, of Paris, Dr. Foelsing, Dr. Zerener, and others, viz., raw hide is capable of combining with its equivalent weight of tannic acid in from 4 per cent. to 38 per cent. (according to the process employed) of the time taken when electricity and mechanical apparatus or electricity alone is not applied.

I give particulars of some experiments which I have made, bearing on the action of the electric current. Let us first consider what happens when a current is passed through a carefully filtered solution of tannic acid, made from an oakwood extract, using platinum electrodes. The cell employed was divided into three by two porous clay diaphragms, each compartment being of equal capacity, 200 cc., and containing 150 cc. In the first compartment was placed the anode, and in the third the cathode, the intermediate one completing the circuit. A current of 0·0024 ampère was applied at a P.D. of 7 volts. On completing the circuit the following actions took place; at the anode bubbles appeared and collected round the wire as

a straw-coloured froth; at the cathode there was considerably more evolution of gas, and the froth produced was darker in colour and showed streaks of dark red colouration radiating from the wire. After passing the current for 90 hours it was stopped, and the electrodes and liquor examined. The anode had a small quantity of soft, brown precipitate on its surface ($\frac{7}{8}$-inch by $\frac{3}{4}$-inch) which was easily soluble in warm, distilled water, and was absorbed by hide powder: the cathode was covered closely with a hard, dark-brown coat of precipitate to the depth of from $\frac{1}{64}$-inch to $\frac{1}{32}$-inch at the edges. This precipitate is insoluble in hot, distilled water, but is immediately dissolved on addition of a very small quantity of H_2SO_4, forming a clear tan-coloured solution which is bleached on treatment with hide powder, thus proving the precipitate to be a dark, tanning colouring matter.

On examining the liquid in the three compartments, No. 1, containing the anode, was as clear as at the commencement of the experiment, so was No. 2, both having a slight coat of tannin anhydride on the bottom; No. 3, containing the cathode, was somewhat turbid with dark brown particles, which were soluble in hot distilled water and absorbed by hide powder.

At the end of the experiment it was found that in the compartments 1 and 2 the level of the liquid had fallen and in 3 it had risen.

The above gives a general view of the action, which I have amplified as follows:—

1. To compare the endosmose effects in solutions of tannic acid, at varying potential differences, at varying strengths of tannic acid, and with diaphragms of different materials.

2. To compare the precipitation of anhydride, &c., in solutions of tannic acid, when a current of electricity is passed through them, and when allowed to remain during the same time and under the same conditions, but without passing a current.

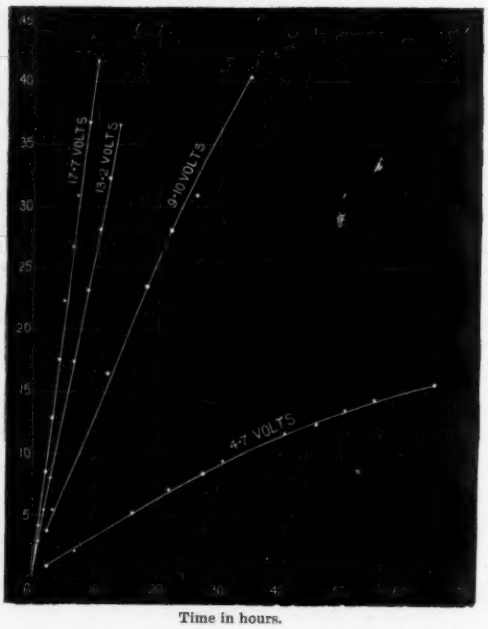
3. To examine the amount of tannin in the liquor before and after passing an electric current.

I.—ENDOSMOSE.

Cells were made consisting of two ebonite boxes (each having one side cut away) fastened together with a plate of porous clay or leather between them, thus forming two compartments, joined through a porous diaphragm, each having a capacity of 200 cc. In experimenting, 100 cc. of the liquor to be examined was placed in each compartment, and the current applied from accumulators, &c., through platinum electrodes, and the variation of level with time noted; the top and bottom surfaces of the cells were made parallel and carefully levelled during experiments. Between each set of readings the clay diaphragm was cleaned and allowed to soak in water, so that the mechanical resistance to flow of liquor might remain as nearly constant as possible.

This method was adopted as the apparatus is simple, and if differences of level between the two sides of the diaphragm be considered, evaporation errors are eliminated, as the surfaces exposed to the air are equal in both compartments.

The first experiments undertaken were to see in what way the rate of flow varied with the difference of potentials applied, the results of which are shown in the following curves:—



CURVE A_1, 1 PER CENT. SOLUTION OF TANNIN.

From A it may be seen that:—

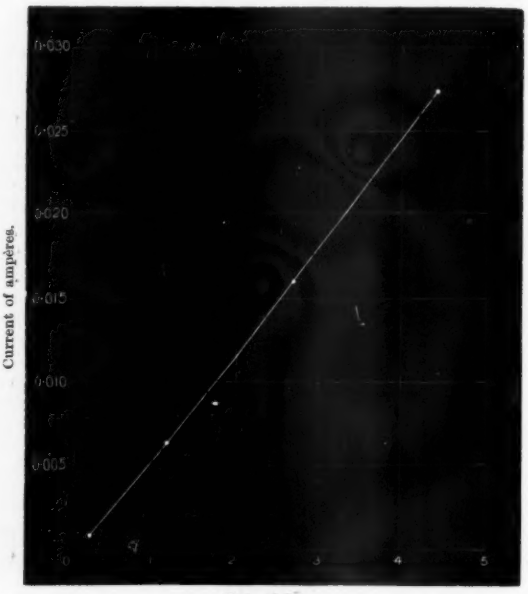
(1) With an approximately constant mechanical and electrical (at one voltage) resistance, the rate of flow of the liquor varies at a higher rate than simple proportionality to the voltage between electrodes (see columns I. and V.).

(2) The current varies at a slightly higher rate than the rate of flow, as measured by tangent to curve (see columns V. and VII.; see also curve A_2).

(3) The rate of flow approximately varies as the square of the voltage (see columns V. and VI.).

CURVES AND TABLE A_1 AND A_2.

I.	II.	III.	IV.	V.	VI.	VII.
Volts.	(Volts)^2	Tangent to curve.	Mean current by voltameter.	Proportional rate of flow.	Calculated rate of flow.	Proportional current.
4·7	22·09	0·27	0·00089 A	0·22	0·27	0·13
9·0	81·00	1·22	0·0066 „	1·00	1·00	1·00
13·2	174·24	2·71	0·0162 „	2·22	2·15	2·45
17·7	313·29	4·42	0·0274 „	3·62	3·86	4·15



CURVE A_2.

In order that Ohm's law may be satisfied, it follows that the resistance of the tan liquor examined must vary inversely as the potential difference applied. In some experiments I am making on this point, I find that between certain limits of current density, the resistance varies inversely as the electromotive force; but after the solution has been subjected to electrolysis for some time at the higher current density, it loses its power of offering an increased resistance to a lower potential difference, the resistance remaining fairly constant at the minimum value for all potential differences below the high one which broke it down.

This, taken in conjunction with the results given in Division III., points to an alteration in the structure of the tannin molecule being produced by electrolysis, the resinous dark tanning matter being separated in the form of insoluble precipitate on and about the cathode, the remaining liquor being of higher electrical conductivity and clearer, the amount of available tannin remaining constant, although in separate forms. The next experiments were made to find in what way the rate of flow varied with the percentage of tannin in the solution, at constant potential difference, and using the same porous diaphragm in each case.

(To be continued.)

SOME APPLICATIONS OF ELECTRICITY TO CHEMISTRY.* By JAMES SWINBURNE.

I.

IT would be quite impossible to give any adequate idea of the applications of electricity to chemistry in three short lectures. Now that dynamo-electric machines are made which give high efficiencies, and which are low in first cost, the applications of electricity to commercial chemistry are increasing, we may truly say, every week, and the future development of electro-chemical work will be so enormous, that even a bird's-eye view of the subject ought to prove interesting. It will be unnecessary to go into commercial questions; what will be attempted is a glance at the scientific basis of some of the more interesting and more important applications of electricity to chemical industry.

Most of the applications depend on the electrical decomposition of saline solutions, or electrolytes. When electricity is passed through an electrolyte, it is split up into two components, of which one is in a higher, and the other in a lower state of oxidation. In a simple

* A course of three "Tyndall" lectures at the Royal Institution.

case, for instance, of passing electricity through water, oxygen is produced at one pole, and hydrogen at the other. Again, if, for instance, chloride of copper is electrolysed, chlorine comes off at one pole and copper at the other. The copper is said to be reduced, as chloride of copper, though it contains no oxygen, is considered to be in a higher state of oxidation than the original copper, because the chlorine takes the place of oxygen. Similarly, chlorine is, in chemical language, in a higher state of oxidation than a chloride, because it is obtained by oxidising a chloride; for instance, by treating it with sulphuric acid and manganese dioxide. These terms are, unfortunately, very loose, and it would be much better to speak of salts, and of electro-positive and electro-negative radicles, the radicles being the components of the salt that are separated by the passage of electricity. As the terms oxidation and reduction are already so extensively, though loosely, used, and as they apply also to chemical actions performed on bodies which are not electrolytes, it will be better to adhere to their use.

A glance at the work of the chemist shows that a very large proportion of his labours consists in oxidising or reducing the various substances with which he deals. Sometimes he is making changes or substitutions, but his chief work is oxidising and reducing. Here, then, we have at once the reason why electricity is becoming so important. Consider for a moment the advantage of the electrical over the chemical method. Take the case of water already mentioned. To reduce it to hydrogen it would have to be, let us say, heated in contact with iron, carbon, or something which has enough affinity for oxygen to abstract it from water. In this case, the hydrogen is set free but the oxygen is not; it is combined with another body. Again, to oxidise the chloride some such treatment as that with manganese dioxide and sulphuric acid is necessary. By electrolysis, however, the oxygen and hydrogen, or the copper and chlorine, are produced direct without any complications and without introducing foreign substances. When it is remembered that many of the ores from which metals are obtained are oxides, and that the smelting of these consists of reduction only and is carried out in a manner which gives impure metals, and that the remaining ores are mostly sulphides, which are roasted into oxides and then reduced, it will be realised that electricity has a magnificent future in metallurgy. This is not by any means all. The important alkali industry consists of splitting up common salt into caustic soda and chlorine, and the process of manufacture, as at present carried on, is a bewildering maze of oxidation, reduction, and substitution. In making alkali and bleaching powder by the Leblanc-Weldon processes, beginning with salt and pyrites and ending with caustic and chlorine, there are, taking it favourably, four oxidations, one reduction and three substitution processes. By electrolysis, salt is decomposed into caustic soda and chlorine at one operation without the aid of any other chemicals, and without any waste, loss, or by-product. Direct electrolysis of solutions of salts is by no means the only process available; fused salts can be electrolysed, and aluminium is reduced extensively from its salts by this method. It is probable that sodium and potassium will soon be produced from their fused salts in the same way.

Electricity provides the chemist with still another powerful method for treating refractory substances. If electrical energy is spent rapidly in a confined space, so that the heat produced cannot escape easily, any temperature may be reached short of the melting or volatilising points of the materials employed. This is the electrical furnace, which will be dealt with in a later lecture.

The oldest, and by no means the least important, application of electricity is electro-plating. The process of electro-plating with silver, gold and nickel, is so well known that it will be better not to devote the short time at disposal to their consideration, except to mention a few recent developments. Electro-plating with silver containing a small percentage of cadmium or "Arcas" plating is a recent improvement. The sulphide of cadmium is yellow, and as it combines with sulphur more readily than silver, it is said to absorb the sulphur and to form a thin coating of cadmium sulphide, which protects the silver, so that it is not blackened by fumes of sulphuretted hydrogen. Prof. Silvanus Thompson strongly advocates the substitution of cobalt for nickel, as it does not tarnish so easily, and does not become yellow. Mr. J. W. Swan has also recently developed processes for rapid deposition of copper for electrotype and such purposes.

The metal deposited by electrolysis is, unfortunately, in a crystalline condition, and this is frequently a source of trouble. As a striking example of abnormal molecular state, Gore's explosive antimony may be mentioned. This is electrolytically-deposited antimony, in which the particles appear to be under constraint, or in a state of unstable equilibrium. If the metal is touched with a hot wire it undergoes an internal change by which it develops so much heat that it rises to a high temperature. A rod of tin, which has been thickly coated with a deposit of antimony, can be melted if the antimony is discharged. The metal here almost seems to be in an allotropic state, as in the well-known cases of plastic sulphur, or iodide of mercury. Several metals are deposited in trees or masses of fine crystals, which are so bulky that they cannot be dealt with practically. This is the case, for instance, with lead in acid solutions. In alkaline solutions the deposit is closer. Many of the more easily oxidised metals, such as sodium and potassium, cannot be deposited by electrolysis from aqueous solutions, as the metals themselves decompose water. It is curious that they can be deposited into mercury, forming an amalgam. The amalgam itself will, in some cases, decompose water, but more slowly, and the attraction of the mercury for the sodium or potassium seems to partly counteract the tendency to form the hydrate. The affinity of mercury for these metals is so strong, that they flash when they make contact with mercury. It is a remarkable fact, however, that in some cases the metal seems to be deposited not in the mercury, but on its surface, amalgamation taking place afterwards. This can be seen easily in the case of lead. Lead trees can be formed on the surface of the mercury, but the least vibration will cause the mercury to amalgamate the tree and draw it in. A slender tree a few inches long will be drawn in, and amalgamated so quickly that the eye cannot follow the motion. The amalgam of aluminium is instructive. When it is exposed to the air, the aluminium oxidises and produces a sort of white fur of alumina. The combustion of the aluminium is sometimes rapid enough to cause considerable rise of temperature. This shows that aluminium does not really remain clean and bright, but that the surface oxidises and a thin protective layer of oxide is formed which prevents any further action. It is this layer which prevents the metal being soldered easily, especially as there is no flux which will dissolve alumina without attacking the aluminium. In the case of amalgamation, the oxide does not protect the metal from further action, as it cannot adhere to the surface of the mercury; the oxidation, therefore, goes on till the aluminium is oxidised. Electro-deposition is now largely practised in copper refining. Crude copper is cast into anodes and placed in vats of sulphate of copper with thin sheet copper cathodes. The copper is dissolved off and deposited on the thin cathode plates. The silver and gold fall to the bottom, with various impurities, such as antimony and arsenic. The silver and gold are thus completely separated, and the crude copper is changed for the much more valuable pure product. Lead would be treated in much the same way, if it were not that it is apt to deposit in a loose spongy form, instead of in a coherent mass. Electrical processes are also coming into use by which many of the ores are merely roasted to convert them into oxide, and then dissolved in acid, the solution being electrolysed to yield the metal in a state of almost perfect purity.

One of the most important applications of electricity will be, as already hinted, in the manufacture of soda and bleaching powder direct from salt. If a solution of salt is electrolysed, caustic soda is produced at the cathode, and chlorine is given off at the anode. The chief difficulty is to find a good material for the anodes. No metal will do, for all metals would be attacked by the chlorine, chlorides being formed. Carbon is the only material available. It is attacked, to some extent, not by chlorine, but by oxygen; but electrolytic soda has now reached a stage in which this last difficulty may be said to be overcome by using a form of carbon, which is so cheap, that its corrosion does not much matter. At Snodland there is a model caustic plant at work, which has been making soda and bleaching powder by the ton for some time. The solution of caustic made by the process described contains a great deal of undecomposed salt, which is a drawback, and to overcome this difficulty, a very ingenious arrangement has been recently proposed by Kellner and by Vautin. As has just been explained, sodium can be deposited into mercury, and this property is utilised in a curious way. The anode is in one chamber, and the cathode in the other, and the two are separated by a partition of mercury. Two complete cells are thus really produced. In the chlorine cell the carbon is the anode, and one side of the mercury is the cathode. Sodium is deposited into the mercury. In the caustic compartment the other side of the mercury forms the anode, and the sodium is dissolved out, hydrogen coming off at the cathodes. By this means the caustic is obtained pure, without the admixture of salt.

If, on the other hand, the caustic is allowed to mix with the rest of the liquid, chlorine is no longer given off, but the salt is changed to hypochlorite of soda. This may be used for bleaching. If the operation is now carried on at a higher temperature, chlorate is formed. Chlorate of potassium is now manufactured on a large scale from the chloride in this way.

So far, we have chiefly considered the commercial application of electricity. It must be remembered that it was by electrical means that sodium, potassium, magnesium, lithium, strontium, barium, and calcium, were first produced. All these metals, with one exception, were first isolated by Sir Humphrey Davy, Professor of Chemistry at the Royal Institution. More recently, electrolysis has been used in the endeavour to isolate fluorine, by electrolysing fluoride in a vessel made entirely of a fluorids. In chemical analysis, again, electricity can be a great help. By its means metals can be separated which are troublesome to deal with by purely chemical methods. As an example of the application to analysis, testing for arsenic in forensic cases may be mentioned. It has been usual to evolve hydrogen from zinc, the hydrogen being contaminated with arseniuretted hydrogen if arsenic is present. Unfortunately, zinc is apt to contain arsenic, and where the life of a human being may depend on the result of a test it is most important to avoid all chances of error. The hydrogen should, therefore, be evolved electrically from a platinum plate, so that at least one source of error is eliminated.

One of the most complicated branches of the study of chemistry is the formation of dye stuffs. Oxidation and reduction can frequently be carried out by electrolysis without introducing special oxidising and reducing agents. Here, then, is a wide field for scientific research. Dr. Goppelsroeder has done a great deal of work on the subject, but it is well worthy of further attention. Whether such a process is valuable commercially is a matter of doubt, but it provides the chemist with a new method of investigation, and may lead to important discoveries in this branch of organic chemistry.

Electricity also derives benefits from chemistry. Faraday discovered that the quantity of metal deposited was strictly proportional to the quantity of electricity passed through the solution. This has provided electricians with a very exact method of measuring quantities of electricity. Lord Rayleigh has made very careful determinations of the exact weight of silver deposited by a unit quantity of electricity, and this measurement now serves as the practical standard for the measurement of electricity, and hence of electric currents.

Various experiments were made during the lecture, showing the decomposition of water, the translation of copper from one pole to the other, the production and properties of sodium and aluminium amalgams, the production of caustic and bleach, the production of oxygen and hydrogen by electrolysis, and the production of aniline colours.

D

NOTES.

Key Speed in Telegraphy.—The actual rate at which telegraphists can signal is well exemplified in a contest which was recently held in New York by the Telegraphers' Mutual Relief Association. For ladies, 500 words was the task, and the competitor who gained the first prize for "sending," worked at an average rate of 44½ words per minute. In the male competition, W. Gibson, one of the fastest senders in the country, set the pace, and accomplished the remarkable task of sending 97 messages in one hour. The best competitor accomplished 242 words in five minutes, with two errors only, *i.e.*, a speed of 48½ words per minute.

The Board of Trade Transformer Regulations.—The Board of Trade have issued the following regulations for the use of transformers:—"Whereas in certain regulations made by the Board of Trade under the Electric Lighting Acts, and certain provisional orders and licenses granted under those Acts, it is provided that where the supply of energy is transformed at a converting station, some means or apparatus approved by the Board of Trade shall be provided, which shall render it impossible that the low pressure distributing mains shall be at any time charged to a dangerous difference of potential from the earth, owing to any accidental contact with, or leakage from, the high pressure system, either within or without the converting station. And whereas under such regulations it is also provided that where any transforming apparatus is installed on a consumer's premises, some means or apparatus approved by the Board of Trade shall be provided, which shall render it impossible that the low pressure service lines and consumer's wires shall be at any time charged to a dangerous difference of potential from the earth owing to any accidental contact with, or leakage from, the high pressure system either within or without the transformer. Now, therefore, the Board of Trade approve of the following arrangement for use in any case where a high pressure supply of energy is converted to a low pressure supply by alternating current transforming apparatus, as a means of preventing contact between the high and low pressure conductors within such transforming apparatus, viz.:—An arrangement such that, by the construction and winding of the apparatus, any wire or other conductor forming part of the low pressure supply circuit within the transforming apparatus, is separated from any wire or other conductor forming part of the high pressure supply circuit within the transforming apparatus in every part by a wire or other conductor possessing sufficient sectional area, which is efficiently connected to earth, but is not in metallic connection with either the high pressure or low pressure supply circuits."

The Future of Arc Lamps.—There is no mechanism, says *Industries*, used in electric lighting so little studied as the arc lamp. The average electrical engineer knows less about the underlying principles and the actual working of arc lamps than of any other part of his business. No good work has been written on the subject, the nearest being an able paper by Prof. S. P. Thompson. The full theory of the arc lamp, and the design of dynamos and arc lamps to work on series circuits, have never been discussed. The properties necessary for success in parallel running have never been formulated. The alternating arc lamp has received even less attention. All this is apparently because some 10 years ago it was the fashion to talk of arc lamps as out of date in comparison with the more modern incandescent lamp. Here we have a comparison drawn between two lights which cannot be said to compete, because neither can replace the other. The incandescent lamp got the best of the foolish battle, and the arc lamp has remained very much where it was 12 years ago. The senseless feud between the advocates of alternating and direct currents is now producing equally disastrous results. It is quite time engineers studied arc lamps seriously, designed them to suit modern distribution systems, and arranged them to burn cheap carbons without "pumping," and without getting out of order. Mr. Crompton prophesies a great future for arc lamps, and it is certainly curious that the arc is least used in the only country where the incandescent lamp is expensive. Insular prejudice—or, what is much the same thing, insular ignorance—is still extant in this country.

The Royal Society.—The following paper was down for reading before this Society yesterday afternoon:—"Magnetic Viscosity," by Dr. Hopkinson, F.R.S., E. Wilson, and F. Lydall.

Crieff Electric Lighting.—Provost Adie has been making inquiry lately as to the introduction of the electric light into Crieff. An electrician from Manchester recently visited Crieff, and examined the water power in the vicinity. We hear that he has now furnished a report of his investigations. He considers that for an outlay of about £3,000 an installation of about 600 lamps of 16 candle-power each can be secured, and if accumulators are used an additional outlay of about £2,000 will be required, but in that case 2,000 lamps of 16-candle-power each would be obtained. It is reported that waterfall ample for all purposes may be placed at the disposal of the town if the scheme is gone into.

Tiverton Electric Lighting.—The surveyor has drawn up a scheme for electric lighting the town and the estimated cost. He recommends the high pressure alternating current system. The main streets would be lighted by arc lamps of 1,000 to 1,200 candle-power, the side streets by 32 candle-power incandescent lamps, and the courts by 16 candle-power lamps. The arc lamps would be run from sunset to midnight, and a 32 candle-power incandescent lamp switched on for the remainder of the night. The ordinary street and court lamps would run all night. The lighting of shops and houses for private consumers would be by incandescent lamps. Two estimates of cost are submitted by Mr. Siddalls. Under the first the capital outlay upon a station, with water-power, to supply public lighting and 2,000 8-candle lamps for private use, is set down at £13,740, and the annual cost of maintenance, including repayment of loan and interest, at £1,700. With steam-power the capital outlay would be smaller (£10,170), but the cost of maintenance much larger, viz., £2,349 per year. The second estimate embraces a more extensive project—4,000 private lamps, besides the public lighting. To produce this by water-power would require a capital outlay of £17,080, and by steam-power an outlay of £12,640. The annual cost of maintenance in the first of these two would be £2,050, and in the second £2,842. Assuming water to be the generating power, the surveyor calculates on a revenue of £1,800 a year, being £800 for the public lighting, and £1,000 for the 2,000 private lamps, at an average of 10s. each. If 4,000 private lamps were employed, the revenue is set down at £2,800.

Induction Coil for Alternating Currents.—In our March 31st issue, we reproduced an article from the pen of R. W. Wood on this subject, from the *Scientific American*. In our contemporary's issue for April 1st there appears a letter written from Mr. Townsend H. Soren, of 65, Thayer Hall, Cambridge, which reads as follows:—"On reading the article, 'An Induction Coil for Alternating Currents,' in the last issue of your paper, March 11th, 1893, I was very much surprised to find an accurate description of an instrument in use at the Jefferson Physical Laboratory at Harvard College. The instrument was made by Prof. John Trowbridge about ten years ago, and has been used by him on his class lecture table ever since. The writer of your article, a Harvard graduate of the class of 1891, is an assistant in chemistry at the Chicago University, and having need of such an instrument as he describes, he attempted to reproduce the one he had seen in the Harvard Laboratory. As his attempt was unsuccessful, he wrote to Prof. Trowbridge, who furnished him with the description and dimensions that appeared in your last issue. The second attempt to reproduce Prof. Trowbridge's piece of apparatus was not wholly successful, on account of the builder's limited knowledge of the induction effects of periodic currents. He again wrote to Prof. Trowbridge, and was furnished with the explanation of these effects and the method of obviating them, as they appear in his article. The article in your paper was practically made up from Prof. Trowbridge's letters. Prof. Trowbridge, however, informs me that this form of induction coil for alternating currents, with the secondary coil built up about the centre of a long primary coil, was first devised and used by Prof. Rowlands, of Johns Hopkins University."

The "Electrical World's" English Correspondent.—There may be differences of opinion on the real value of foreign correspondence, but when it is so woefully inaccurate as that of our American contemporary, there can be no question of its uselessness. The English correspondent in a recent communication comments on the electric light fatality on the circuit of the House-to-House Company; he is accurate as far as the finding of the jury is concerned, but by some means or other he has arrived at the wild and erroneous conclusion that damages were given to the widow of Lang for £195.

Worcester Electric Lighting.—At the meeting of the Watch Committee last week, the City Surveyor presented a report as to the probable expenditure of constructing a generating station for the purposes of electric lighting at Powick Mills. It was explained that the greater portion of the structure would be subject to the action of running water, and the substructure would be consequently expensive. He estimated the total expense at £10,065, but he submitted an alternative and less costly scheme, which the committee decided to recommend the Council to adopt, the cost not to exceed £9,000.

The Blackening of Lamp Bulbs.—Few subjects have given rise to more speculation than the blackening of the bulbs of incandescent lamps. At one time it was said to be due to platinum thrown off from the leading-in wires. Then it was due, says *Industries*, to something mysteriously called "air-washing." Some people are fond of working mystery into explanations of anything where electricity or high vacua are concerned, so that when they exist together there is a double tendency towards the mysterious. Recently mercury vapour has been said to be the cause of the blackening, but this theory seems to have been developed more especially by American inventors of mechanical pumps, which do not use mercury. There is still another theory, due, we believe, to Sawyer, according to which there is some oxygen in the bulb which combines with the carbon at the very high temperature produced, then deposits the carbon on the glass and goes off to the filament again for more, and so on. It does not matter at all with this theory that there is no known oxide of carbon which decomposes automatically at a low temperature. In a vacuum and in an electric lamp the laws of chemistry ought, it would seem, to be quite different from the humdrum laws of Nature under pressure with no electric current about. It is possible that hot carbon slowly volatilises considerably below its melting point, just as camphor does. This theory would be too simple, however. It would be safer to assume that the difference of potential between the legs of the filament causes currents across the air space—hot rarefied gases being good conductors—and that these cause the carbon to leave the filaments and to be deposited on the glass. The whole subject requires to be investigated carefully, and would probably well repay any time and trouble expended upon its elucidation.

The Potential of Electric Charges.—Very considerable discrepancies exist in the results which have been published by various investigators who have essayed to measure the charge on spheres raised to different potentials; hence a broad review of the whole subject by A. Heydweiller in the *Annalen der Physic und Chemin* [1893, No. 2, pages 213—236], will be found to fulfil a useful object. Experimental work was undertaken in the laboratory at Würzburg which has yielded some rather important data; these are classified in a table which shows in C.G.S. units, the charge on spherical electrodes of various radii, namely 2·5, 1·0, 0·5 and 0·25 cm.

Brighton-Rottingdean Electric Railway. — The National Telephone Company, who were the only opponents to the Bill for powers to construct an electric railway along the foreshore from Brighton to Rottingdean, have given notice of the withdrawal of their threatened opposition, the promoters having agreed to insert a clause for the protection of their wires. The withdrawal of this petition leaves entirely unopposed this projected railway, which is to "be placed at such an elevation as to be safe from interruption by the sea." The Bill came before a Select Committee of the House of Commons on Tuesday last, but the opposition having been withdrawn, it was at once referred to the Unopposed Bill Committee.

Romsey Abbey Electric Lighting.—It is probable that Romsey Abbey will be lighted with electricity during this year.

Church Electric Lighting.—The vicar of Dudley parish church has suggested the lighting of the church by electricity instead of gas.

Taunton Electric Lighting.—A Local Government Board enquiry was held on Wednesday regarding the Council's application to borrow £16,000 for electric lighting purposes.

Rothesay Electric Lighting.—The committee appointed to enquire into the probable cost and the possibility of a scheme of electric lighting of Rothesay, have presented their report. The question has now been postponed for the present.

Falmouth Electric Lighting.—The Lighting Committee's report was up for discussion at last week's meeting of the Sanitary Authorities. It was proposed to engage an expert to report on the matter, but an amendment was subsequently carried postponing the matter for six months.

Ayr Electric Lighting.—The Town Council last week considered the question of taking action under the Burgh Provisional Order, which expires in August next. Enquiries are being made by the Town Clerk. The chairman reported his inspection of the Southampton installation.

Morecambe Electric Lighting.—Some plans of electric cables, proposed to be laid to the West End by the Morecambe Electric Light and Power Company, have been approved.

Claim by a Boy for Heavy Damages in America.—In October, 1889, the Edison Electric Illuminating Company were laying mains along Upper Seventh Avenue, New York. While the excavations were being proceeded with, 25 long pipes containing inflammable material were piled up in the street. A lad named John Coffee was returning from school, and stopped to look at a bonfire near the pipes, when the explosive material in the pipes became heated, and the pipes burst. The boy was struck with the flying pieces, and was picked up unconscious, but subsequently partly recovered. The lad is now said to be a pitiable looking object. He is in a dreadful condition, bordering on collapse. The Edison Company offered settlement, but the lad's father now seeks to recover $50,000 damages. The defendants deny all the allegations as set forth, and charge contributory negligence to the boy. The case was to come on in New York last week, but we have not yet heard the result.

Belfast Electric Lighting.—A special meeting of the Belfast Corporation was held on Tuesday in the Council Chamber of the Municipal Buildings, to receive and consider a report from the Gas Committee respecting Prof. Kennedy's report relative to the electric lighting of Belfast. The report recommended the Council to proceed with the lighting of the central district of the city, and to defer the lighting of the "southern district" or any suburban residential district for some time. The central, or compulsory area, embraces Donegal Place, Royal Avenue, Castle Place, High Street, Bridge Street, Corn Market, and the adjoining thoroughfares, in which many large shops and warehouses are situated. £19,000 or £20,000 is the estimated cost of the installation. The report was adopted, and the Gas Committee were authorised to take steps to carry the recommendation of the report into effect forthwith. The scheme does not include any street illumination.

Leicester Electric Lighting.—We understand, says the *Leicester Daily Post*, that the two contracts for the provision of the electric light at Leicester mentioned at a recent meeting of the Council, and as to which some discussion took place, have been referred to an expert satisfactory to all concerned, with a view of settling all points of controversy. It is stated that he has given a decision in harmony with the recommendation of the Gas Committee, and consequently there can be little doubt now that a contract will be entered into with the Brush Company.

Aberdeen Electric Lighting.—The Northern Co-operative Company are considering the question of electric lighting their premises in Gallowgate, Aberdeen.

Limehouse Electric Lighting.—The Board of Works have decided to ask Prof. H. Robinson, C.E., to report fully to the Board on the subject of electric lighting. The fee is to be 30 guineas.

Winchester Electric Lighting.—The General Purposes Committee of the Town Council have been empowered to enquire into the cost of electric lighting, and the value of the water-power at the city mill.

Nelson Electric Lighting.—The Local Government Board have sanctioned the borrowing by the Nelson Corporation of £6,000 more to complete the electric lighting scheme in the borough.

Society of Arts.—Last Wednesday evening, April 19th, a paper on "Some Economic Points in Connection with Electricity Supply" was read by Gisbert Kapp, M.Inst.Elec. Eng.

The Electric Light Works at Bristol.—The Electrical Committee of the Bristol Town Council have drawn up a report reminding the Council that by their report presented on March 10th, 1891, they informed them that £66,000 would be required to carry out the installation. In consequence of the nature of the soil forming the site of the central electric lighting station, the Committee found it necessary to incur a heavy expense in piling, and in building a retaining wall against the river, and they also found it expedient to erect a larger, and consequently more costly, building than was at first contemplated. Contracts for the whole of the works had been entered into, and the Committee found that it would be necessary to provide £17,000, in addition to the £66,000. The Committee recommend that £17,000 be borrowed on the general district rate.

Electric Tanning.—We commence in this issue the paper read by Mr. Conrad Falkenstein before the Institution of Electrical Engineers. The subject is one of much importance to one of our industries, and it is to be regretted that the paper did not apparently receive that attention and consideration which were so justly its due. But then the subject was one with which the bulk of Mr. Falkenstein's listeners were unacquainted, and the few who did understand it seemed to get but little encouragement to enter into a discussion. Such papers lend far greater weight to the proceedings of the Institution than many of the quasi-advertisement kind with which members have been so often favoured.

Bradford Electric Lighting Extension.—A special meeting of the Gas and Electricity Supply Committee of the Bradford Town Council was held last week, to consider the advisability of extending the electricity works in readiness for next winter. Alderman F. Priestman, who presided, said that the principal problem which presented itself was whether it would be best to extend the plant on the two-wire system, or to begin afresh with the three-wire system. It appeared from a report prepared by Mr. S. W. Baynes, the electrical engineer to the Corporation, that to double the present two-wire mains would cost £9,630, and that the cost of the three-wire system would be £5,970. There would also be a saving in working expenses on the latter system of £424. Numerous applications for light had had to be put off, and to meet the demand for next winter he estimated that from 200 to 300 additional generating horse-power would be required at the works. A sub-committee was appointed to go into the whole question and report to a subsequent meeting. It was exceedingly wise to consult the resident engineer on this subject, and the Bradford Corporation would do well to carry Mr. Baynes's plan into effect, for no one can appreciate the requirements of the district better than he. Apart from this, it is the opinion of electrical engineers of the highest eminence that it would be disastrous to attempt extensions with the two-wire system.

International Society of Electricians, Paris.—At the last sitting of this Society, which was held on April 7th, the elections of the Council of Administration took place. As usual, the president for the year 1894-5 was appointed; M. Postel Vinay, maker of electrical apparatus, being elected. Messrs. Hospitalier and Picou were chosen as vice-presidents. M. Picou was replaced by M. Hillairet as general secretary. Messrs. Roux, Thomas, and Violet were appointed as secretaries. The members elected were: Messrs. Arnoux D'Arsonval, Barbier, Benard, Bergon, Bordet, de Bovet, Delaunay-Belleville, Gauthier-Villars, Géraldy, Javaux, Leblanc, Monnier, Saladin, Tresca, Weiller, Williot. M. Ed. Guillaume communicated a paper on "Modern Ideas on the Subject of the Theory of Electrical Magnitudes." We hope that at the next sitting the discussion regarding the programme of the Chicago Congress will be resumed, it having been postponed in consequence of the elections.

Hospital Electric Lighting.—The question of electric lighting St. Peter's Hospital, Bristol, is being considered.

British Delegates for the Chicago Exhibition.—The British Government have been invited by the American Minister, acting for his Government, to nominate five official delegates for the World's Electrical Congress at Chicago on August 21st and following days. The Royal Commission for the Chicago Exhibition have requested the Foreign Office to nominate the following gentlemen:—Mr. W. H. Preece, F.R.S. (President Inst.E.E.), Prof. W. E. Ayrton, F.R.S.; Major Cardew, R.E.; Mr. Alexander Siemens, and Prof. S. P. Thompson, F.R.S.

Lectures.—A scientific exhibition by Mr. Jerritt, of Mutley, was given at the Mutley Baptist Chapel on Wednesday evening last week. A lecture, reproduced by Edison's phonograph, was delivered on electricity. A model electric railway and a variety of electrical apparatus was exhibited.

On 11th inst. Mr. R. E. B. Crompton lectured in the Hove Town Hall on "Electricity and its Modern Development Popularly Described, particularly in its Application to our Dwellings." Mr. Crompton illustrated his lecture by experiments.

The Institution of Electrical Engineers.—On Thursday next, April 27th, the discussion on the paper on "The Distribution of Power by Alternate Current Motors," by Albion T. Snell, will be continued.

Edinburgh Electric Lighting.—A memorial against the Town Council working the electric light order themselves is being largely signed by the Princes Street and other shopkeepers.

A special meeting of the Lord Provost's Committee is to be held to-day to consider whether the Council shall carry out the electric lighting themselves or transfer the work to a company.

A New Electric Tug-Boat on the Seine.—A new, and apparently a very interesting application of electricity, has just been made in Paris. The electric tug-boat, which had been described by M. de Bovet at the Société des Electriciens, entered into service a little while ago. An official inspection took place on April 7th. A certain number of electricians, starting from Paris on a special boat, went as far as Meudon to meet the electric tug, and returned with the latter to Paris. They were thus able to observe the tug at work. What they admired above all was the regularity with which the chain, which is sunk at the bottom of the Seine, and which serves for towing, is drawn over the rim of the pulley and closes the magnetic field formed by the two sides of the pulley placed at a short distance from one another. They also remarked upon the facility with which the chain was withdrawn after it had done its work. An ordinary tug passed a few minutes before, and it could be seen how, in winding and unwinding of the chain, several turns absorbed the power. It would be interesting to compare the working expenses of the two systems.

The Annual Easter Meetings of the French Physical Society.—There was no great novelty worthy of record at the Exhibition of the Physical Society, which took place on April 4th and 5th, on the premises of the *Société d'Encouragement*. The rooms were lighted by Cance arc lamps, fed by dynamos at 70 volts, worked by compressed air motors. These lamps were provided, for the first time, with transparent diffusing globes, supplied by M. Frédureau, the object of which is to show off the arc to better advantage. The incandescence lamps were provided with globes of the same kind. We come first to the Carpentier exhibit, with some very well constructed apparatus. Among the new instruments are some condensers, and a portable Deprez and D'Arsonval galvanometer for measuring insulation resistances, The firm of Ducrétet exhibited an electric laboratory crucible-with a directing magnet,* an apparatus for repeating Messrs. E. Thomson and Tesla's experiments with high tension and high frequency currents, and a special type of a Serrin regulator for a projecting lamp. M. Cance showed the lamps which he is now constructing with regulating brake for letting down the carbons, and also some cylindrical rheostats with variable slider. M. Gaiffe had some new aperiodic galvanometers on the D'Arsonval system. Messrs. Moissan and Violle show some models of electric furnaces, which enabled them in their last experiments to attain to 3,500°. M. Claude showed a phase-meter, which enables us, by a simple reading, to measure a difference of phase. This apparatus is based on the differential attractions and repulsions of a plate made to vibrate by two bobbins, placed one in direct circuit and one in derivation. M. Blondel had a new standard arc, constructed by M. Werlein, for the photometry of arc lamps. In conclusion, we may mention the Patin alternator, the F. Verdier accumulators, and some photographs of Messrs. Sarasin and de la Rive's apparatus for studying the electric undulations in the air.

The Magnetisation of Iron Rings.—In considering the magnetisation of metallic bodies of various symmetrical dimensions, few are more interesting than the magnetisation of iron rings. The bearings which the general problem and the special modifications of it which can be proposed have upon the practical applications of magnetism, are sufficiently important to lend an additional attractiveness; and excursions into this field of research are rarely barren of result. H. Lehmann has recently been investigating the magnetisation of iron rings slit in a radial direction, and the chief results have been obtained for a ferromagnetic ring, the radius of which is large in comparison with the radius of the section. These results may be summarised briefly as follows:—The demagnetising factor, or the factor which, multiplied by the mean magnetisation, gives the mean factor of the demagnetising force, is constant up to about half the saturation. The co-efficient of dispersion, the ratio of the mean induction to that in the slit, is constant up to half the saturation. The region of the dispersion of the lines of force is limited essentially to the vicinity of the slit, and is narrower as the magnetisation increases. The coefficient of dispersion is independent of the radius of the ring; in regard to its constancy it only depends on the relative width of the ring. Lehmann finds that the empyrical expression for the dependence is a linear one, in which a certain constant occurs. When the value of this constant is known, the factor of demagnetisation can be calculated from the geometrical dimensions of the system. For Swedish iron the value of the empyrical constant is 7; in the case of other ferromagnetic metals, more especially in the kinds of iron used in technical purposes, the values of this constant will not differ widely from this value. The paper in which Lehmann's results are described is published in *Wiedemann's Annalen*, No. 3, 1893, and is full of mathematical expressions. He considers that they may find an approximate application even in imperfect magnetic circuits of complicated shapes.

NEW COMPANIES REGISTERED.

Domestic Telephone Company, Limited (38,563).—This company was registered on the 4th inst., with a capital of £20,000, in 3,990 ordinary or "A," and 10 management or "B" shares, all of £5 each, for the entering into and carrying out an agreement with Sir Charles Stewart Forbes, Bart., for the making of several inventions, and the carrying on of the businesses of a telephone company and exchange, electrical engineers, and manufacturers of all kinds of electrical, telephonic, or magnetic appliances. The subscribers (with 1 share each) are:—C. S. Forbes, Bart., 28, Queen's Gate Terrace, S.W.; J. Mansfield, 29, St. James's Place, S.W., gentleman; J. R. Gibson, 312, Kennington Park Road, electrical engineer; C. Harrison, 67, Lincoln's Inn Fields, W.C., solicitor; C. Hay, 28, Cornhill, E.C., insurance manager; T. D. Croft, 17, Dorset Square, N.W., gentleman; L. T. FitzGibbon, 22, Harrington Road, S.W., gentleman. The number of directors is not to be less than three, nor more than seven, the first being Sir C. S. Forbes, Bart., Hon. J. Mansfield, Hon. Claude Hay, L. T. FitzGibbon, and T. D. Croft. It is not necessary for a director to hold any shares in the company. Registered by Ingram, Harrison and Ingram, 67, Lincoln's Inn Fields, W.C.

Newington, Priddle and Company, Limited (38,544).—This company was registered on the 29th ult., with a capital of £7,000 in £1 shares, to accept and carry into effect an agreement made on the 28th ult. between R. W. H. Newington, E. Priddle, and R. Hail, to acquire and develop certain patents, particulars of which are not given in the momorandum of association, and to carry on the business of electrical and general engineers. The subscribers (with one share each) are:—R. H. Newington, 4, Berry Street, E.C., electrical engineer; E. Priddle, Clerkenwell, E.C., electrical engineer; G. L. Pemberton, Grosvenor Square, W., gentleman; E. L. Heatley, 3, Gracechurch Street, E.C., merchant; R. Hail, 104, Poplar Walk Road, S.E., accountant; A. E. Hatley, Doctor's Commons, E.C., solicitor; E. T. Bernard, 53, Coleman Street, E.C., secretary. The number of directors is not to be less than three nor more than five. Qualification 100 shares. The first managing directors are R. W. H. Newington, Edward Priddle, and G. P. L. Pemberton. Remuneration to be fixed by the other directors. Registered by R. Hewlett, 31, Essex Street, Strand, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Northampton Electric Light and Power Company, Limited.—The annual return of this company has been filed at Somerset House, and shows that out of a nominal capital of £50,000 in 10 "A" and 49,990 "B" shares of £1 each, 10 "A," 10,000 "B" ordinary, and 3,180 "B" preference shares have been taken up. No calls have been made as regards the "A" shares, but the full amount has been called upon the "B" ordinary, 10s. per share on the "B" preference, and £2,875 has been paid on this head.

Northern Electric Wire and Cable Manufacturing Company, Limited.—The fourth annual return of this company has been made up to the 20th ult., and shows that out of a nominal capital of £20,000, in 600 fully paid and 3,340 ordinary shares of £5 each, all the fully paid and 2,167 of the ordinary shares have been taken up, the former of which have been issued to Blakey, Emmott & Co., Limited, of Halifax—a company now in liquidation. There has been an amount of £2 10s. per share called on the ordinary shares, which has resulted in a payment of £5,415. There is still £2 10s. unpaid.

City of Bath Electric Lighting Company and Engineering Company, Limited. — The annual return of this company has been made up to the 4th inst., and shows that out of a nominal capital of £60,000 in 5,500 ordinary and 50 founders' shares of £10 and £100 each, respectively, 3,334 ordinary and the whole of the founders' shares have been taken up. There has been £10 called up on each of 1,084 shares, and the total amount of calls received reaches £10,770. Amounts of £22,500 on 2,250 ordinary shares and £5,000 on 50 founders' shares have been agreed to be considered as paid. There is £70 unpaid.

* See Electrical Review for last week.

Bell's Asbestos Company, Limited.—The annual return of this company was filed on the 30th ult., and shows that out of a capital of £200,000 in £5 shares, 24,000 have been taken up. There has been £5 called on 17,400 shares, and the total amount of calls received is £87,000. There has been £33,000 agreed to be considered as paid on 6,600 shares. The registered office is now situated at 59½, Southwark Street, S.E.

Anglo-American Telegraph Company, Limited.—The annual return of this company was filed on February 10th last, and shows that the whole capital of £7,000,000 is fully paid up.

Woodhouse and Rawson Electric Supply Company of Great Britain, Limited.—A meeting of this company is to be held at 11, Queen Victoria Street, on the 1st of next month, for the purpose of receiving an account of winding-up.

Cambridge Electrical Supply Company, Limited.—The first annual return of this company has been made up to the 17th ult., and shows that out of a capital of £50,000, in £10 shares, 2,306 have been taken up. A call of £8 per share has been made, the result of which is £17,922. There is £526 in arrears.

L. Alwyn, Limited.—The statutory return of this company, made up to the 22nd ult., has been filed, and shows that out of a nominal capital of £2,000 in £1 shares, 1,514 were taken up; 500 of which were issued as half paid. A sum of 10s. has been paid upon the remaining 1,014 shares, and £509 has been received on this account, including £2 paid in advance.

British Insulated Wire Company, Limited.—According to the files at Somerset House, the registered office of this company is at Prescot, Lancashire.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—April 27th. For the mason, concrete, iron, carpenter, plumber, slater, painter, and glazier works of electric lighting station to be erected at Cotton Street, for the Town Council. Drawings may be seen and schedules of quantities obtained from the superintendent on application at the Corporation gasworks.

Dublin.—May 1st. The directors of the Grosvenor Hotel, Dublin, have instructed Mr. Walter Leake, consulting electrical engineer of Manchester, to prepare the plans and specifications for fitting up the whole of the above premises for connection with the City of Dublin electric light mains. Firms desirous of competing for this work must send in their names to Mr. Leake, 30, Victoria Buildings, Manchester, not later than May 1st.

CLOSED.

Whitehaven.—Some months ago, when the electric lighting tenders were accepted, the contract for supplying and laying the electric conductors, which amounted to £5,125, was placed with the International Okonite Company, Limited. The contract was cancelled, however, by the Town Harbour Trustees on March 2nd, because the company had taken no steps to carry out the work. Fresh tenders were obtained, and the contract has now been given to Messrs. Siemens Bros. & Co., their tender amounting to only £4,014. The twelve tenders received varied from £3,365 to £12,456.

Aberdeen.—The contract for the porcelain insulators for the electric lighting system of the city has been placed with Messrs. Stiff and Sons, under certain conditions. The offers were—Stiff and Sons, £200, and Doulton & Co., £250.

BUSINESS NOTICES, &c.

J. A. Berly's Universal Electrical Directory for 1893 (12th year), is now ready, 784 pp. This standard work contains a larger amount of trade information than any other similiar publication, and should be in the hands of every engineer or electrician. Free within the Postal Union for 4s.

Catalogue Distribution.—Catalogue publication, when coupled with judicious distribution of the books, is a capital system of advertising in detail one's manufactures, and in most cases is likely to more than recoup the manufacturer whose appliances and wares are so described, for the expense incurred in their preparation. But if these catalogues, after having a great deal of time, trouble and expense devoted to them are given away in a careless manner, quite irrespective of their cost, it reveals the fact that the company or firm issuing the books have either a great deal of spare cash to throw away, or there is a flaw somewhere in the management. As an example of this, we may mention that at short intervals within the last month or so we have received from a London firm three sets—all precisely similar—each consisting of three different catalogues of electric lighting specialities. This is obviously an unnecessary expense; and might not the money thus injudiciously and unnecessarily expended, have been devoted to a better purpose? There are extremes in regard to this, as in everything else. Some firms decline to part with their catalogues on any account, unless a small figure is paid for them, and so frequently prevent their goods being known where they might have secured profitable business; but, on the other hand, there are manufacturers who, as in the case we mention, apparently give away books of value quite indiscreetly.

Electrical Signalling. — A very perfect system of signalling by means of electricity is in use on the Clifton Rocks Railway. It has been especially designed for the purpose by Messrs. King, Mendham & Co., of Bristol, and erected by them. Water is the motive power used for hauling up the cars; these may have any number of passengers up to 18, and a like number or fewer may be in the upper car, provided there be more wishing to descend than ascend, that state of things may be sufficient to establish a means of working the system, but if the weight on each car be equal or nearly so, then so much water is admitted into a tank on the upper car till it overbalances the lower one, and it begins to descend, hauling up the other car. In order, then, that the engineer at the top shall know the load (extra to his passengers) that is required to over-balance the lower car, it is necessary for him to know the number of passengers coming up; this is accomplished by an ingenious arrangement of contact by which the conductor of a car is enabled to signal up, as the car fills, the number of passengers entering. These signals are received one after another upon a signal board on each side of the engineer, an electric bell ringing at each fresh indication of additional passengers. When the car is ready to start the conductor signals accordingly by means of a special contact, which signal is likewise received upon the board. The engineer knows by gauge on the car at his end when enough water has been admitted into the tank to take the car down, and when he is ready a signal is sent down to an electric bell that the car is starting; a local buzzer is inserted in the circuit, by the sound of which it is known that the distant bell is ringing, and the indicators are reset in the act of transmitting the "starting" signal, so that the apparatus is in perfect readiness for the next journey. Separate electrical contact and indicator boards are provided for each set of cars, and a double set of batteries to ensure the proper working of the whole system and to obviate all risk of a breakdown. Immediately a car reaches the lower end of the tunnel, the water in its tank is automatically discharged into a large reservoir, this water as it accumulates is pumped up to the top, and its varying height is known at the bottom by means of an electric water level indicator (fixed by the same firm), which shows on a dial differences of three inches of level either way.

Southampton Free Library Electric Lighting.—At a meeting of the Southampton Free Library Committee, held last week, the following tenders for the electric light fittings for the New Free Library were submitted:—

Messrs. J. Sugden & Co., London	£375	0	0
B. Verity & Sons, London	£331	4	0
Planet Electrical Engineering Company, London	£329	10	0
Fowler, Lancaster & Co., Birmingham	£297	0	0
Siemens Bros. & Co., London	£288	0	0
Paterson & Cooper, London...	£285	0	0
Brush Electrical Engineering Co., London ...	£278	18	3
Emanuel & Sons, London	£247	0	0
Latimer Clark, Muirhead & Co.	£241	0	0
Crompton & Co., London	£239	0	0
Howard & Co., London	£239	10	0
Barn tt & Co., Newcastle-on-Tyne	£226	2	0
E. P. Fiford & Sons, Southampton	£225	13	0
Sanby & Co., Southampton	£220	0	0
Sharp & Kent, London	£220	0	0
Noble & Co., Southampton	£210	0	0
F. Shalders, Southampton	£209	0	0
F. M. Newton, Taunton	£171	5	0
Donnison & Parmiter, Manchester...	£167	0	0

The last mentioned tender was accepted.

Can it be possible, taking into consideration the estimates of such experienced firms as Messrs. Verity, Siemens Bros., Paterson and Cooper, the Brush Electrical Engineering Company, and others, that the sum of £167 suffices to carry out this work in accordance with the provisions of the specification? We should be glad if any of the competitors for this contract would favour us with full details of the work specified for. A similar instance of the enormous disparity between tenders is exhibited in one of the items tendered for in connection with the Brighton electric lighting, which appears in another column.

Hodges and Todd.—We learn that Mr. Percy W. O. Hodges, A.M.I.C.E., has joined the firm of Messrs. Hodges & Todd, electrical engineers and measuring instrument manufacturers, which firm is now adding civil and mechanical engineering departments to their rapidly increasing business, and they are now in a position to advise and report upon engineering projects, as well as make surveys, &c. In addition to their Turnmill Street works, Messrs. Hodges and Todd have taken extensive premises in Red Lion Street, where central station switchboards, large switches, &c., will in future be made. The offices will still be at Turnmill Street, where all communications should be addressed.

Brighton Electric Lighting.—Special reports from the Works and Lighting Committees of the Brighton Town Council were issued the other day. The Works Committee recommend that the tender of Mr. J. T. Chappell, for the extension of the engine house, the erection of testing rooms, coal store, &c., and other works in connection therewith at the Corporation electricity generating station, North Road, for the sum of £2,839, be accepted. There were five tenders ranging from £5,595 2s. 1d., to £2,839. The Lighting Committee also recommend the acceptance of the following tenders:—

	£	s.
Mr. E. Danks, for supplying and setting three Lancashire boilers	1,475	0
Messrs. Yates and Thom, for supplying and fixing steam and water system and piping, with feed pump	1,295	0
Messrs. Latimer Clark, Muirhead & Co., Limited, for supplying and fixing steam dynamos and motor dynamos	4,894	4
Messrs. Crompton & Co., Limited, for supplying and fixing lamp canopies in accordance with design C., with switches, &c., for lighting the King's Road ...	545	0
Messrs. Crompton & Co., Limited, for supplying 45 Crompton and Pochin arc lamps, for lighting the King's Road	766	13
Messrs. Latimer Clark, Muirhead & Co., Limited for re-winding the armatures of the dynamos now in use at the generating station	450	0
Total	£9,425	17

As many as 46 tenders were received for the work required to be done by the Lighting Committee. The total expenditure involved in the undertakings referred to is £18,952 17s.

The Electric Lighting of Islington.—A most exhaustive report has been circulated by the Special Electric Lighting Committee which was appointed by the Vestry of St. Mary, Islington, to investigate into the various systems, to report upon the cost of introducing it into the parish, and the relative cost of gas and electricity. After reviewing the history of the question, the generating stations visited by members of the committee are described, the action of local authorities is considered, and the comparative cost of gas and electricity is dwelt upon. The conclusions arrived at by the committee are, that the supply of electricity can be undertaken with assured commercial success, and that as soon as the provisional order is ratified by Parliament it is expedient, in the interest of the parishioners, that the vestry should take the necessary steps to carry such order into effect. It is recommended that, as it would be undesirable to have more than one central station in the parish, steps should be taken at once to secure a site as central as possible. High tension alternating transformer system is, in the opinion of the committee, best adapted for private lighting, and that high tension continuous current is most suitable for arc lighting in the public streets. A station should be erected of a capacity of 20,000 lights of 8 C.P., and 80 arc lamps for streets. The committee ask to be authorised to obtain plans, specifications, and tenders for the work, and to select an electrical engineer to prepare such plans. A loan of £60,000 should be obtained for the purchase of site, erection of building and the provision of the necessary plant and mains.

Catalogues.—A new catalogue dealing solely with the "Victor" turbine has been brought out by Mr. Frederick Nell, of Mark Lane. Water-power has been much discussed recently in our own as well as in many of our contemporaries' columns, therefore any new publication on the subject is of interest. The book now published details many improvements that have been made in the "Victor" turbine during the past few years, and enters very minutely into a careful study of each part of the machine and its mode of construction. We have not space enough at our disposal to allow for the book the review it deserves, as it denotes that much time and pains have been devoted to careful and exact compilation, and a great deal of very handy information is given which would be useful to prospective users of water-power machinery. There are about 65 illustrations, some of which might certainly have been better produced and printed, although on the whole the blocks are not at all bad, the printing on the whole being good. A set of tables of turbines or small wheels under heads of various dimensions occupies six pages, and following these are, in table form, the detailed dimensions of the "Victor" turbine.

Electric Light in Newcastle.—The whole of the extensive premises of the Newcastle Co-operative Wholesale Society, in Thornton Street, and the adjoining thoroughfares, have been recently fitted up with electric lighting by Messrs. Ernest Scott & Mountain, Limited, electrical and general engineers, Newcastle, and on Saturday evening the apparatus was formally handed over to the society in the presence of a company of gentlemen. The installation consists of three Crossley patent gas engines, each of 25 nominal horse-power. There are also three dynamos of Messrs. Scott and Mountain's latest and most improved type, specially constructed for gas engine driving. Each dynamo is capable of running easily 400 16-candle-power incandescent lamps. The accumulators are capable of feeding 160 16-C.P. lamps, and are to be used for the lighting of the basement and offices and board-room when the engines are not running. There are between 1,100 and 1,200 incandescent lamps installed throughout the various departments in the building. Outside the building two large Tyne arc lamps have been set up. The whole of the work was superintended by Mr. John Thompson, consulting engineer, of Newcastle.

Eastbourne Town Hall Electric Lighting.—The Eastbourne Electric Light Company have been instructed to fix over the main staircase of the Town Hall an 8-light electrolier.

Personal.—Mr. A. W. Jackson has resigned the position of manager to the firm of Julius Sax, which he has held for the past fourteen years, and is carrying on the same class of business on his own account at 33, Mornington Crescent, London, N.W.

Mr. Chas. Hibbert (late works' manager to the International Okonite Company) has joined the staff of the Edison and Swan United Electric Light Company, Limited.

Londonderry and Nottingham Electric Light Installations.—We understand Messrs. E. Green & Son, Limited, of Manchester and Wakefield have just secured the contracts for fuel economisers to heat the feed water in connection with steam boilers to be erected at the above stations, also at the installation about to be put down by the Great Northern Railway, Holloway Station.

Birmingham Electric Tramway.—We are asked by the Epstein Electric Accumulator Company, Limited, to state that the Birmingham electric tramline has been worked by Epstein accumulators since August, 1892, under a maintenance contract of 1½d. per car mile.

Private Installation.—A dairy-farm and mill at Orpington has been fitted with a number of 16-C.P. incandescent lamps and a "Solar" 1,400-C.P. arc lamp. The work has been done by Mr. J. Torr Todman, of Mansion House Chambers, E.C.

Church Wiring.—Messrs. Sharp and Kent are introducing Andrews's system of wiring into St. Botolph's Church, and we understand there are several other similar installations being carried out in the city.

CITY NOTES.

The Eastern Extension, Australasia and China Telegraph Company, Limited.

THE thirty-ninth ordinary general meeting of this company was held on Wednesday, the 19th inst., at Winchester House, Sir John Pender, G.C.M.G., M.P., presiding.

The SECRETARY (Mr. F. E. Hesse) read the notice convening the meeting, also the minutes of the last meeting.

The CHAIRMAN said that before asking them to approve of the report, he would give them such information as he thought it well they should have. The gross receipts for the half-year under review had amounted to £247,766 against £243,668 for the corresponding period of 1891, showing an increase of £4,108. Notwithstanding the heavy loss on exchange, £11,692, shown on the credit side of the revenue account for the whole year, the loss has amounted to £20,000; but since the close of the half-year steps have been taken, as explained in the report, to avert, as far as possible, any loss in the future from that cause. The working expenditure had amounted to £91,768 against £74,314 for the corresponding period of 1891, showing an increase of £17,454, of which £16,000 was caused by the expenses attending maintenance of cables having amounted to over £38,000 in the past half-year against £22,000 in the corresponding period of 1891. Of that large increase, however, £16,796, or nearly the whole of it, was due to cable expenditure, as shown under Abstract G of the accounts, but which meant not only the various lengths of cable actually used on cable repairs and maintenance, but also the writing down of cable in stock to a reasonable figure. Another exceptional item is the large amount of £6,030 shown on the debit side of the revenue account for income tax, which not only embraces the tax for the particular period, but includes £2,071 for the arrears which accumulated pending the decision of the special commissioners on the company's appeal against the surcharges made by the Surveyor of Taxes, owing to the adjustment of the account. Comparing the figures for the whole year, the result was as follows:—Gross receipts for the year 1892 £494,754, against £508,536 in 1891, or a decrease of £13,782; working expenses for 1892, £171,049, against £141,750 in 1891, or an increase of £25,259; net revenue for 1892 £250,843, against £286,986 in 1891, or a net decrease for the year of £36,143, which was accounted for by the explanation already given. The usual interim dividends have been distributed during the year, making, with the dividend proposed to be paid on 20th inst., a total of 5 per cent. for 1892. It was also proposed to pay a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year. The balance of £74,848 had been carried to the general reserve fund, which now stands at £509,732. The fund was left at that figure after they had expended £1,162,000 out of revenue on cable renewals, duplications and triplications since the formation of the company, and after strengthening and improving the value of the property. Since the last meeting the work of the Singapore-Penang cable had been carried out. A further drawing of debentures took place on the 6th inst. for payment at par in July, when the debenture debt will be thus reduced to £285,000. The repairing ships had, as usual, been fairly employed; but owing to the system being duplicated, the traffic had not been materially affected, except with China and Manilla, which was their single line of cable. A very large amount of traffic came from China. For the last 12 years they had endeavoured to urge the Government to enable the company to duplicate that system; but for some reason or other they had not done this. They were now negotiating with the Government to lay a cable from Singapore which would connect North Borneo on to Hong Kong, securing the traffic under almost any circumstances. The company were not going to spend money out of capital if they

could help it, but if they carried those negotiations to a successful issue it would give them such security as would add very largely to the value and the strength of their property in those waters. All the various sections of the company's system were in good working order. Regarding the increased tariffs to Australia which came into operation on January 1st, the result was that the additional 9d. had not caused any appreciable falling off in the number of words transmitted, consequently the increased rate was practically all profit, and would diminish the loss for the year under review to a great extent. The reduction of tariffs to New Zealand had also received a great deal of attention. The reduction took effect on the same date (January 1st), and up to the end of last month had increased the international traffic by 88 per cent., in other words, the company's quarter risk of loss, based on the first three months' experience of the reduced tariff, was at the rate of £3,168 per annum, and the New Zealand Government's three-quarters risk of loss was £9,563, but as the traffic since showed considerable vitality, and the commercial depression there appears to be passing away, it is not anticipated that the actual losses at the end of the year will be anything like so serious as those figures would represent. The Chinese and Russian telegraph system had been opened for traffic, with the result that the landlines were now competing with the cables for traffic with the cable ports, as well as to the interior and China. As, however, the rates fixed by the Russian-Chinese Convention for the landlines are very little lower than the cable charges, and the working of the landlines was found to be somewhat irregular and unsatisfactory, the competition was not likely to prove serious. The directors, however, trusted that a satisfactory arrangement would be eventually arrived at with the Chinese Administration. After making some further lengthy remarks regarding the attitude of the colonies, the chairman referred to the New Caledonia cable, which was spoken of lately in the papers, to connect with Queensland. That had been very much encouraged by Queensland, but it was like a drop in the ocean, and, while he would feel very glad to see the new cable going on, the principle upon which it was being established was not likely ever to make it a successful cable; but, under the circumstances, it will always be a feeder to the company up to a certain extent. That cable was supposed to be the first link in a chain across the Pacific. He might say without hesitation that to carry their cable across the Pacific they would require a subsidy of something like £100,000 a year. It would never be done by French capital, and was not likely to be done by English. He thought the Eastern Extension Company were the party likely to do it. They had doubtless heard the suggestion of a gentleman who took an interest in the question of the Government buying the cables; in fact, it was on the paper in the House of Commons, and it would come up some day. He would only say that it was a question that would involve something like 35 to 40 millions sterling. If the money was found the shareholders in this company would participate in the benefits accruing from it. If they sold themselves to the government, when the time came it would not make the property less valuable, but a great deal more so than it is now. He congratulated them as shareholders on the report before them, and formally moved: "That the report and accounts of the directors now submitted be received and adopted, and that a dividend be now declared of 2s. 6d. per share, together with a bonus of 4s. per share, both free of income tax, payable on 20th inst., making with the previous distribution a total payment of 7 per cent. for the year 1892."

The Marquis of TWEEDDALE seconded the motion, which was unanimously carried without comment.

The retiring directors, Sir John Pender and Sir James Anderson (who was unable to be present on account of illness), were re-elected.

The auditors, Mr. Henry Dever and Messrs. Welton, Jones & Co., were also re-elected at a remuneration of 100 guineas each.

A vote of thanks to the chairman and directors having been acknowledged by Sir John Pender, the proceedings terminated.

City of London Electric Lighting Company, Limited.

THE following is a full report of this company's meeting held on Thursday, 13th inst., of which we gave a summary last week:—

At the third ordinary general meeting of the company, Sir David Salomons, Bart., presided.

The SECRETARY (Mr. J. Cecil Bull) read the notice convening the meeting.

The CHAIRMAN, after the report and accounts were taken as read, addressed the meeting as follows:—There are several resolutions to be proposed directly, but I expect that you would like to hear a little about what is going on before we come to that point. Every meeting of this company I regard as adding an additional chapter to the history of the electric lighting of the city. It is, after all, nothing more or less than a series of events that form a history which will, no doubt, be as remarkable in its way when we get to the conclusion of it as the history of many companies which have gone before us. Take the first electric lighting company started really on any scale—the London Electric Supply—you have there a history which we have made use of, and many other companies as well; they have paid many penalties in creating that history, and those penalties we have tried to avoid. I have no doubt we shall make errors in the future by every new development, as in the new state of things, which in the ordinary course we shall have necessity to deal with, occasional errors cannot be avoided. I have always told you that we intend to put before our shareholders, not only in this room, but through the columns of the press, all the information in our power, and we shall have a report of this meeting circulated to every shareholder. I do not believe in keeping anything a mystery or making mysteries where they do not exist. There are always negotiations going on which it is not wise to divulge until they are concluded. You have that in your private businesses also, but it is our desire that you should know everything that is being actually done. At a recent meeting a set of accounts was issued which were criticised—I will not say adversely or favourably; they were extremely new, and practically of little value beyond giving a general knowledge of what was being done, but nothing further. The Board of Trade have certain forms which have to be filled up at the end of the year (December 31st); those accounts for last year you have now had, and I do not know whether they could be improved upon or not, but that is a form prescribed by Act of Parliament. It seems—taking it all round—very understandable to the majority of people. I will now tell you the history of the company up till to-day, as near as it can be given. As you know, a report can never contain all that which you can say in a few words. I must first express our great regret at having lost a valued colleague who had taken the greatest interest in this company, not only within the board room but great pains outside—I refer to the late Duke of Marlborough. I also had to express regret on the last occasion we met, that Mr. Charteris, one of the directors, was absent because of ill-health. I told you at that meeting I hoped he would soon recover, and we still hope so, but he is yet an invalid; he has served his country under arms, and I am sure you will agree with us in extending the relief from his duties as we have done. Two of the directors retire by rotation, and the two gentlemen who have offered to retire are Mr. Braithwaite and Mr. Reynolds. They have rendered such valuable services to the company, and being eligible for re-election, I will ask you to place them in authority once more. Mr. Braithwaite is now the chairman of the Brush Company, and takes more interest, if I may say so, in this company than in the Brush Company, not that when he is at the Brush board he neglects their interest, I will not pretend to say that. Mr. Reynolds has done such service that we cannot spare him, unless it were your wish that he should go. The fact of Mr. Braithwaite being a director of the Brush Company, in the sight of many, might be considered a disadvantage that he should be on this board as well. I did feel a little before the company started that it would be a disadvantage for gentlemen connected with the contractors to be on this company, but I have altered my opinion completely since I have found that they work most faithfully for your interests. The contractors, under such arrangements, are tied down to their agreements; they have certainly done their very best to serve you, so that no fault need be found on this score. The officers, including the secretary, the engineer and manager, the engineer of buildings, and numerous other members of our staff, have worked extremely hard to promote your interests—much more than could have been expected from them for the pay they have received, or that may be accorded to them in the future. Statistics, I know, are very dry; at the same time I am going to trouble you with a few, and by-and-bye, when they appear in print, you will have the opportunity of looking through them and seeing how far the company has progressed, or gone back, and what its future prospects are likely to be. In the half year ending December 31st, 1892, £96,000 has been spent on capital account; it is made up in this way:—Machinery and plant, £16,070. The plant in position at December 31st last was sufficient for boiler power, 63,000 8-C.P. lamps; in engines and dynamos, 37,500 8-C.P. lamps; in transformers, 36,000 8-C.P. lamps; on conduits and repaving, including £17,268 for telephone tubes, £34,044 was spent; sundry expenses came to £16,900; that included cables, house services, meters, and such like. That last item includes the 183,686 yards of "ways" laid in 24,810 yards of trench, and cables reach the total of 32,455 yards high tension, and 24,633 yards of low tension cable. The public lighting absorbed £8,176; tools and plant, £298; office furniture, management and general expenses, and so on, came to a total of £1,580, which sum includes the tools and plant. Land and buildings cost £19,169, making a total of £95,939. That was to the end of last year. Now to April 12th, 1893, we stand thus: Total ways laid, taking it in miles, 427 miles; cable drawn in, high tension, 60½ miles, and low tension 35½ miles. The number of lamps which were applied for during the six months ending December last was 21,000 8-C.P. lamps; the number connected during that period was about 8,400; the additional plant, which is now down, has enabled the company to connect 180,000 lamps since the beginning of this year, which result is very satisfactory. We have in the last three months, then, supplied double the number we have done in the six months of last year, the total number being supplied by the company now from the company's mains is 38,200. It must be borne in mind that the supply of current until now has been a source of great anxiety. The demand has been continuous, and we are still running off the pioneer stations which the company took over when it was formed. In order, however, to get over some of our difficulties, we ordered, and have now in position and running, two large half-units, which supply each of them 6,800 C.P. lamps; that is, between 12,000 and 14,000 extra 8 C.P. lamps can be supplied more than when the pioneer station was running by itself. These are now assisting that station, so that a good deal of this trouble with which we had to contend—everybody grumbling that they are not put on first—is being sobered down by degrees. These half-units are driven by ropes, which is not by any means the best method; the permanent machinery to be erected will all be direct driven. The board could not possibly get these direct driven machines in time to meet the demand. They therefore, at a very early period, made a contract with the Brush Company to the effect that when those two machines are not required any more, on the payment of a sum for depreciation, they can be taken out again, and we shall replace them by direct driven machines, so that we have been well served on this point. There are some very large units on order now from the Brush Company, and also from the Laing, Wharton and Down Syndicate. Of the first two large ones in course of construction, the first have been

completed and tested at the Brush Company's works. The final results are not yet known to us, but it ran very well as far as could be observed at the time; it takes a certain period to work out all the figures to know how far we are successful. We have every reason to believe it will give every satisfaction. In six weeks this will be at our station running, or ready to run. The second and third units are well advanced in their manufacture. These machines will each give a supply of current for something like 14,000 8-C.P. lamps. The Laing, Wharton and Down Syndicate are to supply two large machines, which I understand are now ready in America. They are being made over there, but we hope to have them landed here at our works on the 10th ult. We are making every endeavour that, by the end of the year, we shall be able to supply, at any rate, 130,000, if not more, 8-C.P. lamps. If we go on as we are doing now, without any further troubles, no doubt we shall be able to meet what we now try to promise. After mature consideration, the board came to the conclusion that it would be advisable to give up the station at Wool Quay. It would have been a very expensive station to construct; a very large amount of the machinery would have been under water level, and we should probably have had to pump continually to keep the place dry. It was an inconvenient place; it would not be economical to have a double staff, one at Bankside and one at Wool Quay, so we came to the conclusion that it would be more economical to have this station side by side with the one existing at Bankside. This is being done now, and I hope will meet with your approval. These buildings, to which I will refer directly, are being erected in sections, so that one section after another may be built as the demand for current increases. It is no good building up a station four times larger than is required; it would be only loading yourselves with a larger liability. It is much better to go on meeting the demands gradually. The number of lamps in the City will be very large indeed, but it takes time for houses to be fitted up. A number of the new wires do not meet the specification required, and, as is known to you, a great many hesitate about putting in the electric light until they see what their neighbour's experience has been. In a year's time, I believe, judging by the West of London and other parts, so great is the demand after a few people have put the electric light in, and find that they have been fairly treated, others flock in—you will be surprised at the increase. One section of our building is partly in use, and another will shortly be so (as the chairman here showed by certain diagrams on the wall). I desire to direct your attention to several diagrams on the wall. We asked our engineer and manager to draw up an area diagram showing how our capital was divided up. You have in this diagram the whole concern under your eye at a glance. The two area diagrams both illustrate the same point, but are drawn upon a different plan. In the one, the oblong is divided into a certain number of partitions, and in the other every partition is made with an equal base. The first column shows plant, machinery, and transformers, £400,000; next column represents the sum assigned for conduits, £200,000; next column represents mains and buildings, £150,000 odd; next column represents cables, £130,000; next column represents meters, services, lamp-posts, and such like, £120,000; last column represents capital unappropriated for the present, £200,000. The whole of the area thus represents £1,200,000. There are two more diagrams, the top one showing private lighting as at the middle of last year. There were just over 5,000 lights in June last, and the progress has been continually going up and up, and the diagram shows it up to to-day. The bottom curves are the revenue curves, the lower one represents the actual cost, the upper curve indicates the revenue. You will observe that at the same period last year the two ran very much together, and there was no profit; but as soon as the lamps begin to go on, you will notice how the earning revenue or profit curve runs away from the other, showing that we have turned the corner. The time will not be long before we shall be able to supply every place in the City, and Southwark also. That district is a very small matter, but we hope to have that all in the same condition as the City before long. We only got the provisional order for that comparatively recently. I daresay you have walked through the streets of the City pretty often of late, and seen the progress of the lamp-posts. They are nearly all up now; there are just a few that have not been decided upon as to their exact position by the City Commissioners. As soon as they have decided regarding the remainder, they will be put up. The difference between the main thoroughfares and the lesser streets was that the former were to be lighted by arc lamps, while the lesser streets it was proposed to light with incandescent lights. We were to light the main thoroughfares at once, and the lesser we were to wait and receive the order for after the manner of lighting had been decided upon. We hope soon to receive the order for that. I should like to say a few words in respect to the telephone tubes. It is a question that is of great importance to all Londoners, and a great deal has been said in the papers from time to time on the subject. You will doubtless like to hear how matters stand. When the company was formed, powers existed by which we could lay as many spare tubes as we wished. The company knew at that time Parliament would shortly be asked to give facilities for the laying of telephone tubes underground, and the board were rightly informed as to this, as in course of a short time an Act came into force enabling electric lighting companies to lay tubes for telephone companies, or to lease spare tubes they may have had in the ground themselves. Your directors are too well aware of the enormous inconvenience which the public suffer during the time that the trenches are open in the streets. When the traffic is stopped or diverted, or is impeded, at any rate, a good deal of bad language is used by Londoners in consequence. Gentlemen cannot keep their appointments as they wish to do. Foot passengers are driven into the road. There is a lot of loose earth lying about when the trenches are open. Nobody blesses an electric lighting company when they are operating in the streets. You have only to picture to yourselves what would occur if, after pulling up the streets for our purposes, they had to be pulled up a second time. We hesitated to accept such a responsibility, and therefore we laid in a very large number of spare tubes, believing they would be necessary in a very short time. They were laid in, not only with our desire to spare the City a great deal of trouble in the future, but they were laid with the knowledge of the Commissioners. This Act came into force, and it became necessary to see if we could not make use of these tubes in hopes of giving a good telephone service to the City. We had a provisional agreement—an informal agreement—with the New Telephone Company in respect to these tubes. The agreement could not be completed for their use to draw in the twin-wire system without obtaining three consents, *i.e.*, the City Commissioners, the Board of Trade, and the Post Office. So far your directors have failed to obtain the consent of the City Commissioners for the use of the tubes, and therefore these are lying idle at the moment, instead of being used for the benefit of the citizens. I exceedingly regret that this should be the case, because we have worked very hard to satisfy the Commissioners, and when you bear in mind that the City lighting has been on the whole fairly satisfactory, even though our arrangements are practically only temporary, there is not much to complain of. If the temporary arrangements we now have are so good, I think the permanent ones which will shortly come into play will be of such a character that they will beat the best of other companies. Any income that may be derived from these tubes will not go into the shareholders' pockets directly; it will indirectly, no doubt, but it will assist in this way in bringing the sliding scale of the price of current into operation. I think it is only right to tell you that the board would not be true to their trust if they lowered the price in the City until they saw your interests secured, and any facilities the Commissioners may give us to make this company a success, and allow us to reduce the price of current, will not only be benefiting us as shareholders, but also the people they have to look after in the City. On that score alone they ought to do their very best to assist us. As regards the telephone tubes, again, there exists now underground a complete system, and they have been laid at a price very much lower than could have been done had we waited and waited until we had been asked to do it, for the reason that all the tubes were put in at one opening instead of two. All these things make it possible not only for an exceedingly good system to be laid throughout the City of London for telephonic purposes as is to be found in many of the cities in this country, and in some foreign countries, but they could supply their customers at a lower rate. I trust it will not be long before—it would be within another week, if I had a say in the matter—the Commissioners will, without the slightest hesitation, say that those tubes may be used. In the meantime they may not be aware—I do not know if they are—that the overhead wires have been doubled, which is greatly to the disgrace of London and the danger of the public, and if that is allowed to go on to the extent it was in the early days of electric lighting, there will be a great outcry, as well as vast expenditure and inconvenience. The Commissioners, although they have not met us on this particular point, have given us assistance on many other points, and for that we are very grateful. There are some who imagine the board has been very slow in getting on with this work. It will, however, be only two years next August since this company first came into existence. The first six or eight months is practically lost by a company in settling plans, but since then great progress has been made, as you see, by the plans and diagrams here. As to the permanent machinery, special machinery had to be made by the contractors and put down at their works. Alternators and other engines, or other portions of the work, of such a type and so large as had never been made before, have been started. This has all been done. This new plant is down, and the new machines are being turned out as rapidly as could be expected. The chairman here referred, with the aid of the diagrams, to certain difficulties experienced in connection with purchasing a large number of small portions of land, which had caused a good deal of delay. Since the Board of Trade requires a special form of account to be delivered once a year (ending December 31st), it will be convenient to this company to issue their accounts yearly. We have done that this time, and propose to adhere to it in future, but to hold half-yearly meetings, in order that you may know what is going on At the half-yearly meeting there will be no accounts issued, as it would entail an immense amount of work. Our annual meeting will not, as a rule, be as late as this, as it has been delayed this year because of circumstances over which we have no control, but as soon after January or July every year as possible. I now beg to move: "That the directors' report and statement of accounts, and the balance-sheet to December 31st, be, and the same are hereby, received and adopted."

Mr. J. B. Braithwaite, jun., seconded the motion, and said that the progress they had made, in view of all the circumstances which had been brought before them, could hardly be considered other than satisfactory to the shareholders. In undertaking the electric lighting of the City of London, they were undertaking the largest task of the kind ever undertaken by a private company. At this time last year there were less than 5,000 lamps connected to the mains, and now they had 38,000 lamps connected. The number of lamps had thus increased seven-fold. They had at the moment a balance of 30,000 lamps waiting to be connected to the mains. All they had to do was to get their machinery down, and the customers were waiting for them. He thought they might look forward with the greatest confidence to the future. The system adopted for lighting the City made it better for them than any other company in this country. He believed it would be a model on which many other towns would be lighted, and great credit was due to those who had advised the board as to the system to adopt.

Mr. Cutliffe (a shareholder) asked a few questions. He thought the shareholders ought to have half-yearly accounts.

The Chairman, answering, said each lamp earned 14s. a year. The average number of lamps connected in the six months ending December 31st last, was 15,000.

Mr. GEO. HERRING, and others, having made a few remarks regarding the telephone tubes and the public and private lighting,

The CHAIRMAN answering, said that the contract with the City for public lighting was for 21 years, but it could be terminated in seven years. They must not conclude that because there was a loss now on the public lighting, there always would be.

The motion was put to the meeting and carried *nem. con.*

The retiring directors, Messrs. J. B. Braithwaite, jun., and F. W. Reynolds, were re-elected, as were also the auditors, Messrs. Pannell & Co., at a fee of 100 guineas.

A vote of thanks was accorded to the chairman and directors, and the

CHAIRMAN in acknowledging same, said, in answer to a question, that if any more money was required it would not be for some time: the board had not decided whether they would issue preference shares or debentures.

The Metropolitan Electric Supply Company, Limited.

THE directors' report, to be presented at the sixth ordinary general meeting, to be held to-day at Winchester House, reads as follows:—

"The directors submit a statement of the company's accounts for the year ending December 31st, 1892, prepared in the form prescribed by the Board of Trade, under the provisions of the Electric Lighting Acts of 1882 and 1888. The capital expenditure, which at the end of 1891 amounted to £486,926, now stands at £550,859 16s. 11d. This increase is chiefly due to the laying of additional mains, and to the works in connection with the new station at Paddington, which, it will remembered, was not contemplated in the original estimates. For the purpose of completing the company's present system it will be necessary to issue the balance (£50,000) of the £100,000 debentures already authorised. The gross revenue for the year amounted to £54,571 19s. as against £43,747 1s. 3d. in 1891, or an increase of £10,824 17s. 9d. It will, however, be remembered, that the revenue of that year included a special item of £3,027 1s. 3d., paid by the contractors. The actual increase, therefore, amounts to £13,851 19s. The balance to the credit of the revenue account, before providing for depreciation, is £18,168 1s. 1d. The directors have set aside £4,000 as a depreciation fund, carrying to the credit of the net revenue account the sum of £14,168 1s. 1d., which, with the balance brought forward from the last account and other receipts, makes a total of £15,144 11s 3d. After deducting bank charges, debenture interest, &c., there remains a balance of £12,558 18s. 1d., of which the directors have appropriated £1,000 in reduction of the preliminary expenses account, which will now stand at £4,052 10s. 4d. The directors recommend that a dividend of 4s. per share be now paid, which will absorb a sum of £9,980, carrying forward the balance of £1,578 18s. 1d. to the next account. A comparison of the present revenue account with that for 1891, will show that the directors' anticipations as to the increase in percentage of net profit are being fulfilled, and they look forward with confidence to a continuous increase in the proportion of net profit to gross revenue in the future. The number of 8-candle-power lamps supplied by the company, which at the end of 1891 was 82,000, increased during the year 1892 to 124,000. The number at the present date amounts to 134,453. It will be noticed that the rate of increase is constant, and the applications continue to show steady progress. The generating station at Paddington is completed, and in regular and satisfactory operation. A report from the company's chief engineer is appended, with reference to the condition of the stations, machinery and plant. The directors have appointed Sir Eyre Massey Shaw, K.C.B., to a seat on the board. In accordance with the articles of association, the following directors, viz., Sir John Pender, G.C.M.G., M.P., Sir James Anderson, and Sir George Elliot, Bart., retire from the board, and, being eligible, offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., retire, and offer themselves for re-election."

REPORT OF CHIEF ENGINEER.

To the Directors of the Metropolitan Electric Supply Company, Limited.

Gentlemen,—I have pleasure in certifying that the company's stations, machinery and plant are being maintained in a satisfactory condition, and have worked without interruption up to the present date.

FRANK BAILEY, *Chief Engineer.*

April 11th, 1893.

ABSTRACT OF ACCOUNTS to December 31st, 1892.

CAPITAL ACCOUNT.

Dr.	£	s.	d.
To expenditure per last account	486,926	6	10
„ further expenditure to December 31st, 1892 ...	63,933	10	1
	£550,859	16	11

Cr.	£	s.	d.
By ordinary shares of £10 each	498,741	9	0
„ Founders' shares of £10 each	1,000	0	0
„ Debentures at 5 per cent.	50,000	0	0
„ Balance	1,118	7	11
	£550,859	16	11

REVENUE ACCOUNT.

Dr.	£	s.	d.
To Generation of electricity	27,577	14	6
„ Distribution of electricity	292	15	3
„ Proportion of rents, rates, and taxes	2,645	5	2
„ Proportion of management expenses	5,470	4	0
„ Proportion of law and Parliamentary charges ...	33	8	0
„ Special charges	384	11	0
„ Depreciation fund	4,000	0	0
„ Balance	14,168	1	1
	£54,571	19	0

Cr.	£	s.	d.
By Sale of current per meter { less reserve for doubtful debts, &c. }	50,852	11	6
„ „ „ under contract { less reserve for doubtful debts, &c. }			
„ Rental of meters, converters, &c.	3,095	1	6
„ Transfer fees	46	10	0
„ Other items	577	16	0
	£54,571	19	0

NET REVENUE ACCOUNT.

Dr.	£	s	d.
To Bank charges and commission, interest account, interest due and accrued on debentures, amounts written off for work done, not recoverable, and on account of preliminary expenses	3,585	13	2
„ Balance applicable to dividend on ordinary stock or shares	11,558	18	1
	£15,144	11	3

Cr.	£	s.	d.
By Balance from last account, less dividend paid 1892	464	19	10
„ „ revenue account	14,168	1	1
„ Discounts	511	10	4
	£15,144	11	3

GENERAL BALANCE SHEET.

Dr.	£	s.	d.
To Capital account	549,741	9	0
„ Sundry tradesmen and others, on construction of plant, machinery, fuel, &c.	23,129	15	4
„ Sundry creditors on open accounts	1,545	15	6
„ Depreciation fund	4,000	0	0
„ Net revenue account, balance at credit thereof ...	11,558	18	1
„ Temporary loans	6,000	0	0
	£595,975	17	11

Cr.	£	s.	d.
By capital account	550,859	16	11
„ Cash at bankers	2,264	18	2
„ in hand	82	19	6
„ Sundry debtors for current	23,706	1	11
„ Other „	636	13	9
„ Stores on hand	6,370	9	9
„ Deposits with vestries, &c.	5,812	10	6
„ Sundry debtors for amounts paid on account of contracts in course of completion	2,189	17	1
„ Preliminary expenses, less amount charged to net revenue account	4,052	10	4
	£595,975	17	11

The Indo-European Telegraph Company, Limited.

THE directors' report for the year 1892, reads as follows:—The company's revenue from all sources for 1892 amounted to £117,479 13s. 10d. as compared with £116,699 3s. 1d., for 1891, showing an increase of £780 10s. 9d. The expenses were:—On commercial and general account, £31,960 8s.; on maintenance account, £30,188 8s. 3d: total, £62,148 16s. 3d., as against £61,108 12s. 10d., for 1891, an increase of £1,040 3s. 5d. Deducting the above expenses, taking credit for £5,983 15s. 4d. brought over from 1891, and debiting income tax, there remains the sum of £60,057 16s. 11d. From this amount £10,000 has been placed to reserve, and that sum, together with £10,625, amount of interim dividend, have to be deducted, leaving a balance of £39,432 16s. 11d. The directors now propose the declaration of a dividend for the six months ending December 31st, of 17s. 6d. per share, making, with the dividend already paid, 6 per cent. for the year and a bonus of 20s. per share, both free of income tax, making in all 10 per cent., carrying forward £7,557 16s. 11d. to the credit of 1893. The reduced tariff with the Australian colonies, introduced on May 1st, 1891, under agreement with the colonial governments, has undergone a slight augmentation with the object of diminishing somewhat the rather considerable losses occasioned. The directors trust that the still largely reduced tariff at present in force may be enabled to be permanently established. The directors, on a careful review of the whole of the circumstances, do not think it necessary in the case of such a small undertaking to apply the machinery of the Forged Transfer Acts. The former director-general of telegraphs for Germany, Herr Hake, having retired, has been succeeded by Herr Scheffler, the present director-general. The following directors retire by rotation, and offer themselves for re-election: C. W. Earle,

Esq., and C. Holland, Esq. In case any shareholder should be unable to attend the general meeting, he is requested to fill up and return the proxy form, duly signed, so as to reach the company's office not later than one o'clock in the afternoon of the 26th instant. Holders of shares to bearer must deposit their shares, with name and address, at the office of the company, 48 hours before the time appointed for the meeting, against an order of admission. The share warrants will be returned after the meeting. The transfer books will be closed from the 14th to the 28th instant, both inclusive. The auditors, Messrs. C. F. Kemp, Ford & Co., public accountants, retire and offer themselves for re-election.

Hastings Electric Light Company.

THE annual meeting of the Hastings and St. Leonards Electric Light Company was held in the Auction Room, under the Public Hall, on Friday, 7th inst. Mr. H. M. Baker, J.P. (chairman), presided.

The report reads as follows:—

"The directors regret that some delay has taken place in issuing the report and balance-sheet for the past year, which is due to their having to wait for the accounts to be audited by the Board of Trade, in accordance with the provisional order. The sad death of the late engineer and manager (Mr. E. T. Mercer) is deeply regretted by the directors, who had the highest opinion of the value of his services. He has left a widow and four young children unprovided for, and the directors, feeling that the shareholders would desire to recognise the valuable services rendered to the company by the late Mr. Mercer, propose to submit a resolution to vote the sum of £50 towards the fund being raised for the benefit of Mrs. Mercer and her family. The past year has been one of steady progress in the prosperity of the company, and the additional machinery which has been provided, and which can be worked with greater economy of fuel, as well as the increase in the number of customers, must ensure satisfactory results in the future. The annexed accounts show that, after paying all working expenses, and charging to that account repairs, interest on mortgage and debentures, there remains a net profit of £755 8s. 2d., including the balance brought forward from the last account. The directors propose to pay out of this sum a dividend of 5 per cent., which will absorb £569 2s. 11d., leaving a balance of £186 5s. 3d. Messrs. F. J. Parsons and F. Noakes retire from the directorate by rotation; they are eligible, and offer themselves for re election. The auditors, Messrs. Hart Brothers, Tibbets & Co, also retire, and offer themselves for re-election."

The CHAIRMAN said before moving the adoption of the report, he would like to take a short retrospect of the history of this company. He intended simply to compare the past with the present, which comparison he thought encouraged them for the future. There was a time when they were opposed, and laughed at; notice was given them by their bankers to pay off their mortgage; the gas company threatened to have a writ issued unless their unfortunate chairman became personally responsible for the amount owing to them. Against all these things in the past they now had the best public and private lighting business of any provincial town in England, they had got machinery which was second to none, they were one of the best customers of the gas company, they had reduced their mortgage from £4,000 to £3,000, and their bankers were pleased to take 4 per cent. interest instead of 5. Last, but not least, by a curious coincidence he supposed that at that very moment the Town Council were confirming an agreement entered into by the Corporation with this company for lighting the whole length of the Front Line with electricity. After referring with regret to the death of their respected manager, Mr. Mercer, Mr. Baker proceeded to allude to one or two items connected with the balance-sheet. Now 10 per cent. was taken off the net profit, and the amount, £70, accredited to the reserve fund, thus forming a nest egg for the future. Their receipts, the chairman further on remarked, for the last quarter of the past year were less than might fairly have been anticipated, but it was universally admitted that in these three months there was a state of general depression in the town, and the hotels, their principal customers, used a considerable amount less light. Then their expenditure increased by the fact that they introduced a large dynamo, which was capable of lighting three or four times the amount they did. However, he was pleased to tell them that since the commencement of the current year their increased consumption had been enormous, and with regard to the future, he took it they could do almost as much as they could possibly manage. They had applications in all directions, but it was a very difficult matter to carry mains to the extreme west of St. Leonards, on the hills for instance. He moved the adoption of the report and balance-sheet.

Dr. SHORTER seconded, and the motion was unanimously carried.

Mr. BAKER then alluded to the suggestion in the report to vote the widow and family of the late Mr. Mercer the sum of £50, and in the course of some remarks on the value of their deceased manager, said that it had come to their knowledge that on more than one occasion a much more lucrative position had been offered to Mr. Mercer, but he told them he meant to remain with this company, and look forward to the future to make up, by increased salary, for the time he spent with them in their younger days. Unfortunately that prospect had been suddenly shattered. The two firms with which they largely dealt, the Brush Company and Glover & Co.—Mr. Edmunds, of the latter company, had stated to the directors that Mr. Mercer had never asked for nor received one single penny in the shape of fees for business done with them—had each promised fifty guineas towards the fund being raised for Mrs. Mercer and her four young children. The directors suggested £50, but left it in the hands of the shareholders to say what amount should be voted by the company to the fund.

The Rev. J. W. TOTTENHAM said he would like to see the company give 100 guineas to the fund. Mr. Mercer rendered most valuable services to them at a time when he could have received a far higher salary elsewhere, and he thought the widow and children had strong claims on them. He moved that they vote 75 guineas to the fund.

Dr. CAMPBELL seconded, and the proposition was carried.

Dr. SHORTER proposed the re-election of the retiring directors (Messrs. Parsons and Noakes).

The motion was unanimously agreed to.

The auditors were also re-appointed, and a vote of thanks was passed to the Chairman.

New Shanghai Electric Company, Limited.

AT the company's fifth ordinary general meeting, held on March 28th, the report which was passed included the following paragraph:—

"The directors are again able to report satisfactory results from the working of the company during the twelve months ended December 31st, 1892. The balance at credit of working account is Tls. 8,612.06, as against Tls. 8,116.16 in 1891; this balance, added to Tls. 790.28 carried forward from last year's profit and loss account, gives a total of Tls. 9,402.34 available for division. The appropriation of this amount recommended by the directors is as follows:—

			Tls.
Dividend of 7 per cent. to shareholders			3,339.00
Depreciation on plant, say:—			
10 per cent. on book value, December 31st, 1891	Tls. 40,941.71	Tls. 4,094.17	
5 per cent. on additions during 1892 ...	17,867.70	893.39	
			4,987.56
Directors' fees			300·00
Carrying forward			775.78
			Tls. 9,402.34

"Seeing that the '1892 new plant' has practically all been added during the last three or four months of the year, the depreciation of 5 per cent. is very liberal. Including the above appropriation, the amount written off for depreciation since the formation of the company in October, 1888, will be Tls. 13,708.41, and the directors can confidently state that the amount at which the plant will then stand is exceedingly moderate, and far below replacing cost."

Phonopore Company, Limited.—The fourth annual general meeting of this company was held on Wednesday at Winchester House, the Right Hon. Sir Mountstuart E. Grant Duff, G.C.S.I., presiding. The Chairman moved the adoption of the report, and said that when he became connected with the company he did not expect that the liabilities would turn out to be so large as they ultimately did, or he would have stipulated that the company should have first settled with the inventor. If that had been done he would not have had to announce on the present occasion that before long there would be another call of 2s. 6d. upon each preference share. After explaining that something like £4,500 of the expenditure shown in the accounts would not recur, the Chairman alluded to Mr. C. E. Spagnoletti having joined the directorate, and said he hoped they would shortly, with the aid of that gentleman's experience, be able to work the phonopore over very long distances, when they would have a large market for the instruments in a great many countries. Mr. E. F. Webster seconded the resolution, and the report and accounts were subsequently adopted, after a discussion of considerable length.

Great Northern Telegraph Company of Copenhagen.—The director's report for the year 1892, just issued, shows the traffic receipts, together with balance on December 31st, 1891, and sundries, as £357,556 11s. 4d. Under the head of expenditure, salaries and wages, are given at £41,375; expenses of stations, offices, and agencies, £7,615 18s. 11d.; ordinary supervision and maintenance of the sea and land lines, and repairing steamers *H. C. Orsted* and *Store Nordiske*, £15,442 2s. 10d.; instruments and cells, £3,015 17s. 7d.; maintenance of buildings, £595 5s. 2d.; rates and taxes, £3,265 18s. 5d.; travelling expenses, £373 13s. 11d.; bank commission, &c., £2,294 13s. 7d.; sundries, £383 5s. 10d.; 5 per cent. interest on debentures, 1883 issue, and amortisation of 100 debentures, £20,750. The board propose distributing the balance as follows:—Interim dividend already paid, £75,000; final dividend proposed of 7s. 2d. per £10 share, £54,166 13s. 4d.; reserve and renewal fund, £83,333 6s. 8d.; pension fund of the staff, £2,777 15s. 7d.; directors remuneration, £1,500; balance to be carried forward, £45,666 18s. 9d.

West India and Panama Telegraph Company, Limited.—The directors recommend dividends for the six months' ended December 31st, 1892, of 6s. per share on the first and second preference shares, and 6d. per share on the ordinary shares, placing £1,500 to reserve and carrying forward £1,430.

TRAFFIC RECEIPTS

The City and South London Railway Company. The receipts for the week ending April 16th, 1893, amounted to £861; week ending April 17th, 1892, £734; increase £127; total receipts for half-year, 1893, £13,717; corresponding period, 1892, £12,495; increase £1,222.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending April 14th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,187.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation April 13th.	Closing Quotation, April 20th.	Business done during week ended April 20th, 1893. Highest.	Lowest.
195,100*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	101 —104	101 — 104	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	52¼— 53¼	51½— 52½xd	52½	52¼
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	92 — 93 xd	92 — 93 xd	92⅞	92
2,876,140*l*	Do. do. Deferred	Stock	12⅝— 13½	12½— 13	13½	12½
130,000	Brazilian Submarine Telegraph, Limited	10	11½— 12	12 — 12½	12¼	12
36,400*l*	Do. do. 5 p. c. Bonds	100	100 –103	100 –103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	105 —109	105 —109	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3 — 3¼	3¼— 3½	3 5/16	3⅛
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛— 2⅜	2¼— 2½	2 7/16	2⅛
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	105 —107	108 —110	109	106½
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
630,000*l*	City and South London Railway	Stock	37 — 39	37 — 39	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	12 — 12½	12¼— 12⅜	12⅜	12¼
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	10½— 10⅝	10½— 11	10⅝	10 7/16
$7,716,000	Commercial Cable, Capital Stock	$100	165 —170	140 — 150	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	¼— ⅜	¼— ⅜	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5⅛— 5⅜	5⅛— 5⅜	5 5/16	5⅜
16,000	Cuba Telegraph, Limited	10	11½— 12½	11½— 12½	12½	12¼
6,000	Do. do. 10 p. c. Preference	10	18 — 19	18½— 19½	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½— 3½	2½— 3½	2⅝	2⅜
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅝— 11⅞	11¾— 12	11 15/16	11⅞
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	15 — 15¼xd	15 — 15¼xd	15¼	15 1/16
70,000	Do. 6 p. c. Preference	10	16¼— 16⅜xd	16¼— 16⅜xd	16⅜	16⅜
1 5 900*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,:94,100*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	114 —117	114 —117	115½	115¼
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15½— 15⅝	15⅝— 15⅞	15 13/16	15 15/16
70,600*l*	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	103 —106	104 —107	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 —106	104 —107	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	112 —115	113 —116	115½	115
108,700*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	102 —105	103 —106	...	...
146,800*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	103 —106	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	...	...
49,900	Electric Construction, Limited, Nos. 101 to 45,100	10	2½— 3	2½— 3	...	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1/16— 3/16	1/16— 3/16	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	⅛— ⅜	⅛— ⅜	1/16	½
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd,	2	½— ⅝	½— ⅝	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1 — 2	1 — 2	..	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜— 10 xd	9⅜— 10 xd	10	9 15/16
180,042	Do. do. 6 p. c. Preference	10	15½— 15½xd	15⅝— 15⅝xd	15⅝	15 1/16
150,000	Great Northern Tel. Company of Copenhagen	10	19½— 19⅝	19½— 19⅝	...	...
200,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	107	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½— 5½	4½— 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6½— 7½	6½— 7½	...	..
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	22 — 23	22 — 23	22½	22¼
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	43 — 46	43 — 46	44⅜	44
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½— 3½	2½— 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4¼— 4⅜	4¼ — 4½	4¼	4 1/16
10,000	Do. do. fully paid	5	5⅞— 6¼	6 — 6¼	5¼	...
38,348	London Platino-Brazilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	..
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	7¼— 7⅜	7 — 7¼	7⅜	7¼
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 —105	102 —105	...	...
454,747	National Telephone, Limited, Nos. 1. to 438,984	5	5¼— 5⅜	5¼— 5⅜	5 7/16	5 5/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	15 — 15½	15 — 15½	15½	15 1/16
15,000	Do. 6. p. c. Cum. 2nd Preference	10	14½— 14⅝	14½— 15	14⅝	14⅜
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5⅛— 5⅜	5⅛— 5⅜	5⅜	5⅛
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	113 —116	113 —116	115	114½
48,800*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,451	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5½— 6½	5 — 6	5 5/16	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	⅛— ¼	⅛ — ¼	...	...
11,802	Reuter's Limited	8	7 — 8	7 — 8	7⅜	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7¾— 8¼	7⅜— 8¼	8	7⅞
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	7¾ — 8¼	...	...
3,381	Submarine Cables Trust	Cert.	120 —125	120 —125	121½	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3 — 3½	3 — 3½	3 1/16	...
37,350	Telegraph Construction and Maintenance, Limited	12	32 — 35	31 — 34	34	32
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	104	...
58,000	United River Plate Telephone, Limited	5	2½— 3	2 — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 —100	90 — 100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	5½— 6½	5½ — 6½	...	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	101½	100½
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2 — 3	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	105 —109	105 —109	...	...
64,242	Western and Brazilian Telegraph, Limited	15	7⅞— 8¼	7⅞ — 8¼	8	7 15/16
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5⅞— 6¼	5⅞ — 6¼	5⅞	5 13/16
33,129	Do. do. do. 5 p. c. Deferred	7½	1⅞— 2¼	1⅞ — 2¼	2	1 15/16
178,:00*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	106 —109	106 —109	...	...
222,700*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	106 —109	106 —109	...	..
88,321	West India and Panama Telegraph, Limited	10	1⅝— 1⅞	1⅝— 1⅞	1⅛	1 1/16
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11½— 12	11½ — 12½	12	11⅞
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9½ — 10½	9½ — 10½	10	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	108 —111	108 —111	110	...
1,316,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
169,000*l*	Do. do. 6 p. c. Sterling Bonds	100	101 —104	101 —104	103½	...
99,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½— 6	5½— 6	5⅞	...

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5, (fully paid 5½—6.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100 –103.—Electric and General Investment, shares of £5 (£1 paid 1½—2½.—Founders' shares, 200—225.—Electric Construction Corporation, 6 per cent. Debentures, 95—98.—Electricity Supply Corporation, Ordinary of £5 5—5½.—House to House Company (£5 paid) 1½—2½.—Do. 7 per cent. Preference of £5, 5—5½.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅜—5⅝ xd, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6—6½ xd.—Liverpool Electric Supply Shares of £5 (fully paid), 5⅛—5⅛ xd.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating, 6 per cent. £100 Debentures, 101—103.

Bank rate of discount, 2½ per cent. (January 26th, 1893).

MODERN GAS AND OIL ENGINES.

UNDER the above head Mr. Spies contributes to *Cassier's Magazine* descriptions of modern gas engines, together with some prefatorial historical remarks. All gas engines are stated to possess one feature in common, namely, that the working fluid receives its heat in the working cylinder, not in a separate vessel. This is the cause of the superior efficiency of the gas engine over the steam engine, and a better efficiency is only waiting to be attained until some means are devised for keeping the cylinder as hot as it would become if not cased in a water jacket. It is well known that the efficiency of any heat engine depends upon the ratio of the difference of the initial and final temperatures of the working fluid to the initial temperature. A large proportion of the gas produced by the combustion in a gas engine is steam; but this is largely diluted with nitrogen, due to the excess of air admitted. This excess of air, or nitrogen, is responsible for the fact that the initial temperature of explosion is so much below that of the actual combustion of hydrogen; but even this reduced temperature is too high, and the water jacket is required.

The first gas engine was that of Barber, patented in 1791. This provided for gas generation in a separate vessel, its subsequent cooling and collection in a reservoir, whence it was fed by a compressor to the working cylinder; apparently this was an anticipation of Otto, Dowson, the Caloric engine, and Clarke. In 1794 Mead and Street patented—the first, a resemblance to the free piston engine of Otto and Langen; the second, an anticipation of Brayton's petroleum engine, but in place of petroleum, using turpentine flashed upon a heated cylinder bottom.

Nearly 30 years elapsed before another patent was issued, in 1823, and now there are hundreds all very similar. The patents issued in the last century, 100 years ago, apparently embody everything in use to-day in the most successful engines, so that the monopolies enjoyed on some patents appear a little surprising.

It was the Lenoir engine which first opened up the commercially successful period for gas engines, and this was a double-acting engine, having an explosion at each end of the cylinder every revolution. Hugon followed with his water-spray engine, and this water-spray idea has always appeared to us a better method of reducing the high temperature than the water jackets. Some use was made of the heat in the cylinder.

In Brayton's engine of 1873, which followed the free piston engine of Otto and Langen, ignition of an explosive mixture was made in the working cylinder, the gas coming through a gauze, which prevented the flame passing back to the gas store or receiver, after the manner of the safety lamp; but trouble with this detail led Brayton to change this engine to use petroleum instead. Mr. Spies, however, classes all the oil engines as gas engines, their principle of action being so nearly identical.

He divides them, then, into three main divisions:—1. Those which draw in a charge during the first portion of the piston stroke and explode about mid-stroke, work being done on the piston during the later portion of the stroke. The once familiar Bisschop was of this class. 2. Engines with a compressor which feeds the working cylinder with a mixture which ignites and expands as it enters; and, 3. The now familiar compression engines, which give the most economical results; compression and then ignition at constant volume giving a high initial pressure. By compression, of course, the initial pressure due to the explosion of a mixture at atmospheric pressure is raised proportionately with the number of atmospheres of compression. The free piston engine is given a classification of its own without, we think, any good reason. In this engine there was a device for raising the piston to make it draw in its charge of gas and air, and after explosion, the piston travelled freely against the atmospheric pressure. This was really when the work was done and stored in the shape of potential energy of position. When the gases in the cylinder cooled and formed a partial vacuum, the piston fell again under gravity and the atmosphere, and acted through a special slip clutch upon the fly-wheel shaft. The difference of action is thus not sufficient to place this engine outside class (1). Reference is made to the cost of working engines with gas, manufactured under the Strong patents in New York, which was consumed at the rate of 35 feet per horse-power hour, the gas being worth 25 pence per 1,000 feet, and one pound of coal yielding 27 feet of gas. A horse-power hour was thus produced from 1¼ lbs. of coal. Dowson gas is produced, says Mr. Spies, which yields a horse-power from 1·2 lbs. of coal.

The remainder of this first instalment of Mr. Spies's article is purely descriptive, and need not be further referred to. The illustrations are merely external views from photographs, except for a section of the Otto slide valve engine and another of the Day engine, and some line drawings, also external views only.

Whilst it must be allowed that progress in gas engine practice has been fairly satisfactory, it should be admitted that faults are allowed in this engine which would not be allowed in any steam engine. Especially is this the case with engines running light and missing explosions; the effect of an explosive stroke then adds too much to the wheel speed, and the range of speed becomes undesirably wide. For pumping, air compressing, and for, perhaps, most general purposes and very many machine shops, no inconvenience arises from this, but the same cannot be claimed for electrical and many manufacturing works, and the gas engine of the future will, we are inclined to believe, differ in this particular. An ordinary Otto at 160 revolutions has only the number of impulses of a steam engine at 40 revolutions. It is of great size for the power it develops, and the strains in it are heavy and varying. So far, it has been very considerately treated, much as a new baby is not subject to the stricter rules of the household; but we are now becoming alive to the fact that it is a very old baby, and ought to be at school. The novelty having worn off, we may expect that the gas engine will have to stand on its merits without favour. Given this position, improvements may be expected. As to petroleum engines, from the high prices asked for these, we may conclude that the makers do not even expect them to be employed, unless in cases of Hobson's choice.

THE NIAGARA TURBINES.

A VERY full account of the Niagara turbines from the pen of Mr. Clemens Herschel appears in *Cassier's Magazine*, in which we are presented with drawings not only of the Fourneyron wheels designed by Faesch and Piccard, which have been adopted, but also of the Jonval wheels of Escher Wyss & Co.'s design, which was submitted in the competition.

We have previously described the peculiar feature of the Niagara Falls scheme—the tunnel tail-race, which seemed the only method of utilising the fall on a large scale, and need not specially refer to what Mr. Herschel has to say thereupon. He states clearly that American wheel builders were not prepared to supply such wheels as fitted the requirements of the case, for Americans really manufacture turbines on the ready made clothing system, and the user has to buy the nearest fit, irrespective of its being exact. Wheels are rarely built to order in the way to which we in Europe are accustomed. This gave European builders a better chance in the field of competitive design. It appears that in America a turbine is built to an idea, tested, altered repeatedly in some particular till no improvement is found possible, then other details are similarly treated, and, we suppose, the wheel is finally tested in the flume at Holyoke, and sent out as an 88 per cent. wheel—a figure, of which, however much we may respect it, we may retain the freedom to stand in doubt.

As recently remarked in our columns, wheels which are to be kept within saleable dimensions cannot well have the flat angles which are necessary to a high efficiency. Continental engineers naturally favour the Jonval or Fourneyron turbine; but at Niagara these two types do certainly offer a free outlet for the water, and where a large power is to be obtained and water is plentiful, a specially high efficiency is perhaps hardly likely to be sought until the outlet tunnel becomes choked. The design of the Jonval wheel by Escher Wyss and Co. resembles that of Faesch and Piccard in two particulars. There are two wheels, hence the enormous pressure of the column of water can be balanced, and the regulator sluice is an external cylinder. The lower wheel is fed upwards to attain the first condition, the large flume being carried into the pit

and curved up to an outlet, which is closed by the guide wheel. After passing through the wheels the water is directed outwards into an annular chamber surrounding them and escapes horizontally to the tail-race. The wheels are thus submerged, unlike those of the Fourneyron design, which are placed clear above tail level. The lateral discharge permits of the cylindrical regulating sluice, this is practically identical in each design, and, while merely checking outflow, preserves a full wheel at all times, and does not cause the reduced efficiency of part gate working that is so marked a feature of many regulators which allow the wheel to run with partially filled passages.

The governor in each case is of the centrifugal order, operating on the sluice in the case of the Jonval design by aid of the hydraulic pressure of the fall itself, the governing apparatus being just above the tail-race level, the hydraulic cylinder carrying a rack-ended piston rod to work in a toothed pinion on the winding spindle of the sluices. The sluices are hung also on racks, both worked by one wheel on this spindle. They therefore balance one another, moving in opposite directions.

The fashionable turbine to-day in America is the twin wheel on horizontal shaft, and it was attempted to use this type, but the difficulty of driving by ropes to the surface, or of excavating subterranean dynamo chambers to fit the requirements of the wheel, proved too much, and the European designs prevailed. The power of a wheel being 5,000 H.P., smaller powers will be let off by electrical transmission. It would not pay to sink wheel-pits for small powers, and as much as 1,000 H.P. will probably be thus transmitted, and of 500 H.P. certainly.

Wheels of Jonval type, of 1,100 H.P., have already been constructed for the Niagara Falls Paper Company by R. D. Wood & Co., of Philadelphia, and much resemble the design of Escher Wyss Company, whilst the Fourneyron wheels of the accepted design are now being built by I. P. Morris and Company, also of Philadelphia, for the large central station of the Niagara Falls Company itself. They are rated at 75 per cent efficiency. Is not this rather high for the outward flow type of wheel?

With their large diameter and easy passages they may, however, attain to this if carefully made and finished. We note they are to be of bronze, in one casting.

APPLICATIONS OF OZONE.*

[FROM A CORRESPONDENT.]

APPENDIX.

THE long description of small ozone generators was unavoidable, and I do not think that, with the exception of the Thenard apparatus, I have omitted a single one which is worth noticing, either for its construction and good working or for its originality.

Not one of these apparatus is of any practical and commercial value except for inhaling or for spreading ozone in rooms, and there would be no applications of ozone but for laboratory experiments if there were no alternating current dynamos and transformers.

The development of electric lighting is due to the progress in the construction of the dynamo; the ozoniser is no longer a toy; it is a tool, a useful and powerful instrument, and we owe this to the growth of the induction coil which has become the transformer, giving 5,000, 50,000, 100,000 volts, and even one million volts. Where is the limit for the production of ozone when such a gigantic force as the transformer is at our disposal for producing electric effluvia.

VILLON OZONISER.

This apparatus reminds us of the Beane condenser. Fig. 30 represents a series of boxes or elements each of which is an ozone generator. Cold water circulates between these elements; the two pipes on the top serve, one for the inlet of the air and the other one for its outlet, when ozonised. The ozoniser consists of copper plates, very close one to the other, and covered or insulated by means of porcelain. Mr. Villon writes that he has discovered the principle of the commercial production of ozone by means of high frequency and high tension current, but evidently his discovery is rather tardy. Was not the Rhumkorff coil a high tension and high-frequency apparatus? In spite of the circulation of cold water, the Villon ozonisers must develop a great amount of heat. The drawback is that the electrodes are imprisoned close to each other in a box, and their efficiency therefore must be very limited.

There is nothing striking in this ozone generator. Mr. Villon says that his ozonisers, according to the number and size of their elements, can produce from 500 litres to 500 cubic metres of ozone per hour. Ozone here means ozonised oxygen, or ozonised air. His ozonised oxygen contains, according to him, 20 per cent. of ozone; his ozonised air contains 3 to 4 per cent.; he adds that at a temperature 0°—20° C. he has produced oxygen containing 50 per cent. of ozone. It is quite insufficient to tell us that such and such apparatus gives such and such results. These statements are mere commercial advertisements, unless we are told that a given volume of air passing at a certain speed

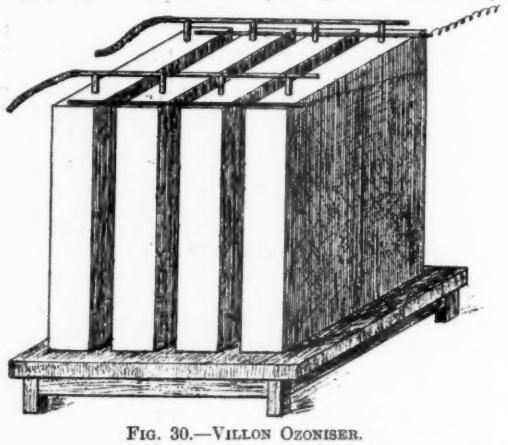


FIG. 30.—VILLON OZONISER.

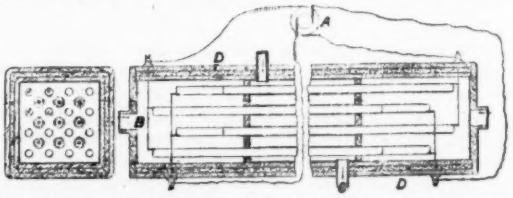
through a given number of electrodes, each of a certain size, has been transformed within a certain time into ozone in such and such proportion, under the action of a transformer and an alternating dynamo giving so many volts; then we must also know the analytic method adopted in the determination of ozone.

Another apparatus devised by Villon consisted of aluminium or copper gauze, between two glass sheets. The edges of the metallic electrodes were coated with an insulating cement. His boxes were 20 inches wide, 22 inches high, and 30 inches long, and contained 55 plates. The heat developed in such an apparatus no doubt was very great.

Mr. Villon has proposed to submit chlorine between two glass plates to the action of the discharges of a high tension machine. He says that this gas, thus electrified, will have a very great decolorising power. Mr. Vernon (*Chem. News.*, Vol. 63, p. 57) says just the reverse, that is, that the electric silent discharge has no action on chlorine. Mr. Villon says, also, that a mixture of air and oxygen with chlorine gives a bleaching agent to which he gives the old name of chlorozone. Mr. Villon ought to have mentioned the name of Dr. Thorne on this well known question.

D. KORDA, 1892.

D. Korda, who is adverse to the use of plain condensers, has devised the following arrangement:—The rings with a dot represent glass tubes which are silver coated inside; *a*, *b*, *c*, *d*,



A is the dynamo, from the four brushes of which two alternating currents are given by the commutators; B is the inlet for oxygen; C is the outlet for the ozonised oxygen; D is a cooling jacket.

FIG. 31.—KORDA.

are metallic tubes, disposed so as to form a square around each central ring, and *a* is connected to one brush, *b* to a second one, *c* to a third one, and *d* to the fourth brush of the commutator of this alternator.

* The concluding article of this series appeared on March 31st, 1893.

The description of his ozoniser needs little comment, and I fail to see what are the advantages of having a central glass tube, silver coated inside, in the midst of four metallic tubes, which are connected each to one of the four brushes of an alternator lagging a quarter of a period behind each other. It may be very ingenious to utilise what Korda calls a rotatory magnetic field ; but this arrangement of tubes, which is simply a combination of several Babo tubes, would be much better if they were more numerous round the central one and also closer. As regards the rôle of the dynamo, and its four brushes and of the lags, it may be original, but cannot be as practical as a good efficient transformer.

Andreoli, 1893.

Fig. 32 and 32 *bis* show the new point bearing electrodes which are used in the Andreoli apparatus for the commercial production of ozone. There are several ways of disposing the points and of forming grids of different sizes.

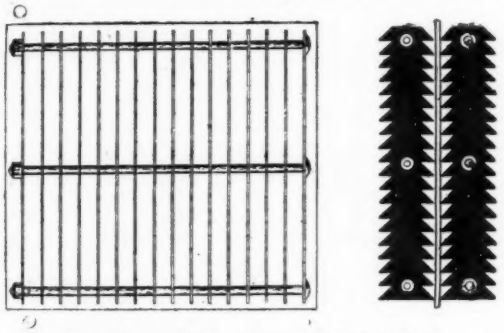


Fig. 32 and 32 *bis*.—Andreoli Ozone Grid.

Two double serrated wires, facing each other, separated by a glass sheet or other dielectric; each wire acts as an electrode, and is connected to one of the poles of the transformer. Section showing a large grid made of serrated wires.

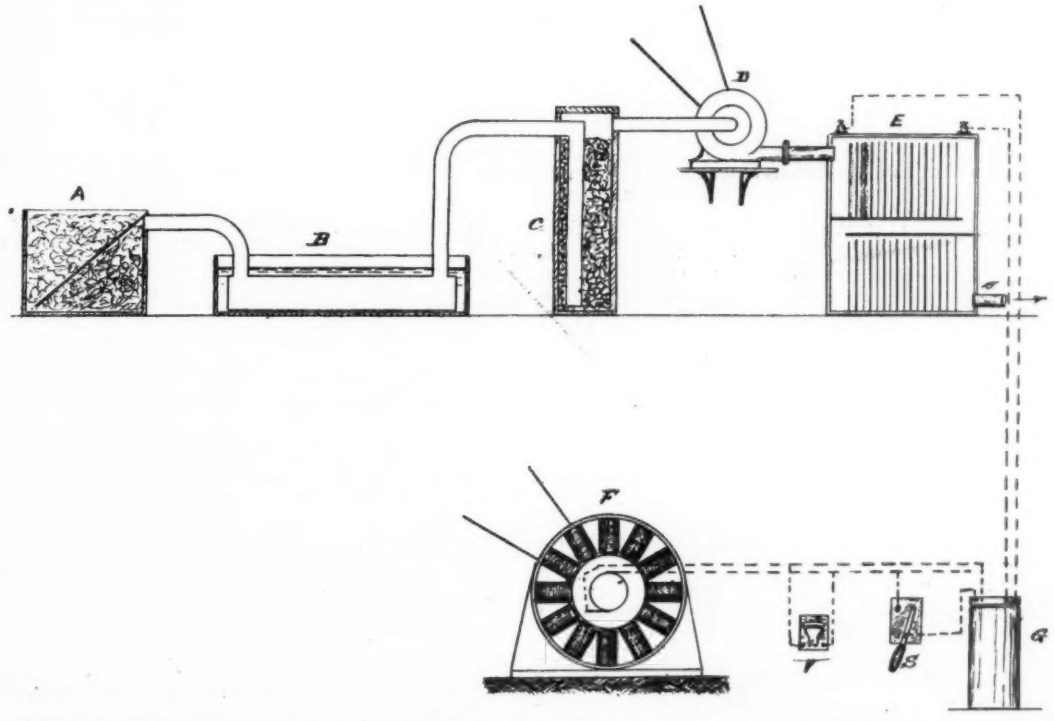
spirit contain organic acids, volatile oil, and other impurities, which, beside their unpleasant smell and taste, have injurious properties. Raw spirits, or new wines, after a few hours ozonisation and a rest of a few weeks in the cask are purified, matured and improved. All impurities which occasion the hot, fiery taste and unpleasant smell are eliminated, and the same mellowness, flavour and bouquet is imparted to them as if they had been kept in the cellar for several years.

The *British Medical Journal* of July, 1890, says : "There is no reason to believe that any extensive system of adulteration is carried on, but the evils arising from the sale of cheap spirit, new and immature, containing fusel oil are terrible." Putting aside the beneficial action of ozone on wines and spirits, of which it improves the quality ; the destruction of fusel oil speaks by itself in favour of the ozonisation of alcoholic liquids. Facts and figures are more eloquent than mere statements and theories. There are in Burgundy, and in other wine districts, as well as in Algeria, several installations where wines and spirits are ozonised. Near Mâcon, within the last four or five years, hundreds of casks of wines are daily treated by ozone.

Purifying Water.—There are many systems ; I have already described the one applied in New York ; the following deserves notice. The ozonised air is aspirated after it has passed through a first filter, by the vein of a descending current of water which forms a sufficient vacuum to draw in the air and carry it with the current. Thus entrapped, the ozone combines more permanently with the water by application of pressure. A glance at the illustration showing the ageing of wines and spirits will make this description very clear.

Chlorate of Potash.—Passed at the same time as chlorine through a convenient solution, ozone quickens and cheapens in a remarkable manner the manufacture of chlorate.

Saccharose and Glucose.—Beetroot juice absorbs ozone and loses its colour. When the odour commences to be strong, the sugar becomes inverted. Under the action of ozone,



A, cotton wool filter; B, cooling apparatus; C, drying chamber filled with coke moistened with sulphuric acid; D, ordinary blower; E, ozonising apparatus; O, outlet of the ozonised air; F, alternating current dynamo giving from 50 to 100 volts; G, 1,000 volt transformer; V, voltmeter; S, switch.

Fig. 33.—Andreoli Ozone Installation at Bethnal Green.

Ageing and Refining Wines and Spirits.—Brewers and distillers are not very willing to listen to any suggestions for introducing ozone into their works ; they are too conservative to allow themselves to be induced in adopting ozone for sterilising the ferments or for preserving beer, or refining alcohol. Still, the beneficial action of ozone on beer, wines and spirits, is undeniable. New wines and newly distilled

saccharin matters oxidise and are transformed into hexepic, tryenic, saccharic, and gluconic acids, which, when exposed to air are transformed into tartaric and paratartaric acid. Leeds has shown that the bleaching of sugar can be readily performed, and that the operation is not attended by any formation of inverted sugar. The bleaching of sugar by ozone is a fact beyond scepticism. The small

quantity obtainable, and the cost of ozone, have been up to the present the sole reason which has prevented its application to the treatment of sugar.

Oils.—According to an old process, the substances are introduced in a closed vessel and a current of ozonised air or ozonised oxygen, is passed through, while the liquid is constantly stirred, so as to bring the particles into most intimate contact with ozone. The experiment may be varied by passing the oils through a reservoir filled with ozone. *Oxidation and bleaching of oils cannot be effected in presence of nitrogen*, but when ozonised oxygen is applied, the oxidation and transformation of the oils take place with surprising rapidity. I would refer with regard to this important point to Dr. Thorne, who made a great number of experiments for oxidising and bleaching oils by means of oxygen.

Everything which oxygen can do, ozone will do much better, quicker and cheaper; but most of the things which are possible if ozone is resorted to, are utter impossibilities if oxygen alone is used.

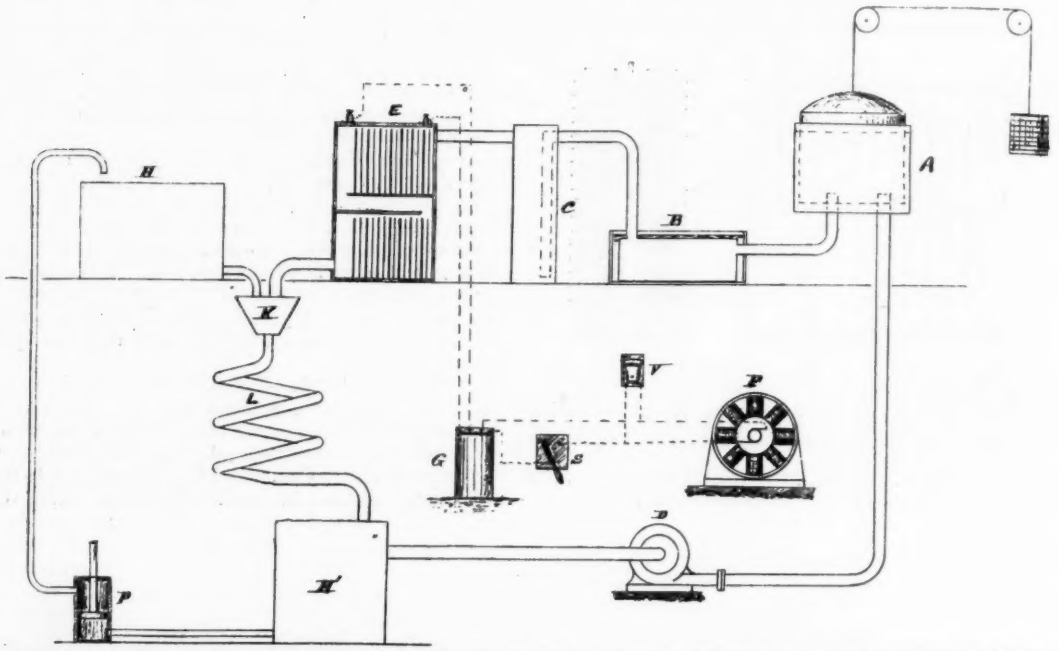
An apparent obstacle to the adoption of ozone is the necessity of purchasing and transporting oxygen; but what could prevent the manufacturers, who have an ozone installation, from having an electrolytic installation for the production of oxygen.

Take this as a fact, oxygen by electrolysis is much cheaper than any chemical oxygen.

The paralysing influence of nitrogen in most of the applications of ozone is explained in a very clear manner by Dr. Thorne, who said that the large amount of nitrogen which passes through chlorine and nascent oxygen liberated carries away some of the chlorine and oxygen before they had time to act.

Camphor.—Mr. De Mare transforms by oxidation camphene (C_{12} H_{18}) into camphor (C_{12} H_{18} O). Oxidation here means simply ozonisation; camphene is distilled from monachlorhydrate of terebenthene and collected in a vessel where ozonised air sublimates it, and precipitates it immediately as camphor of the purest quality.

(*To be continued.*)



A, Gasholder; B, Cooling apparatus; C, Drying chamber filled with pumice stone, moistened with sulphuric acid; E, Ozonising apparatus; D, Ordinary blower; F, Alternating current dynamo; G, Transformer; V, Voltmeter; S, Switch; H, Tank containing the liquid to be ozonised; K, Closed funnel, where the liquid and ozonised oxygen come in contact; L, Worm; H', Collecting tank; P, Pump bringing back the liquid to the upper tank.

FIG. 34.—INSTALLATION FOR AGEING AND REFINING WINES AND SPIRITS (ANDREOLI SYSTEM).

Balloon Society.—A paper on "Telephonic Communication in the United Kingdom," will be read by Mr. A. H. Hastie at the meeting of the Balloon Society at St. James's Hall to-night.

NEW PATENTS—1893.

6,800. "Improvements in or appertaining to electric lighting apparatus or plant for railway trains, tram cars, or other like vehicles." T. J. FLYNN. Dated April 1st.

6,805. "A new shade for lamps or candles, especially suitable for incandescent electric lamps." E. W. STREETER. Dated April 1st. (*Complete.*)

6,813. "Improvements in electrical arc lamps." F. BRYAN. Dated April 1st.

6,814. "Improvements in the deposition of copper or other metal on ordinary insulated conductors." C. R. G. SMYTHE and J. GORDON. Dated April 1st.

6,885. "Improvements relating to electric railways." H. H. LAKE. (Communicated by M. A. Cattori, Italy.) Dated April 1st. (*Complete.*)

6,886. "Improvements relating to commutator switches for use in charging electric accumulators." H. H. LAKE. (Communicated by C. Liebenow, Germany.) Dated April 1st.

6,907. "Improvements connected with the apparatus for raising or lowering the centre lights of chandeliers and electroliers." R. H. BEST. Dated April 4th.

6,921. "Magneto-electric generator with fixed armature." T. ROSATI. Dated April 4th.

6,922. "Devices for electrically heating crucibles and other articles." W. MITCHELL. Dated April 4th. (*Complete.*)

6,933. "Improvements in or relating to the working of signals and locking of points electrically at railway junctions." THE AUTOMATIC ELECTRIC RAILWAY SIGNAL COMPANY, LIMITED, and E. BLAKEY. Dated April 4th.

6,935. "Improvements in meters or apparatus for making measurement of electrical energy." A. G. BROOKES. (Communicated by H. C. WIRT, United States.) Dated April 4th.

6,952. "Improvements in electrically heated crucibles and holders therefor." W. MITCHELL. Dated April 4th. (*Complete.*)

6,954. "Improvements in the construction of primary elements for producing electrical currents by the moisture and heat of the human body or by separate excitation." A. J. JARMAN. Dated April 4th.

6,965. "Improvements in and relating to electric furnaces." R. URBANITZKY and A. FELLNER. Dated April 4th.

6,975. "Improvements in or connected with apparatus for periodically completing and interrupting electric circuits." E. L. BERRY and F. HARRISON. Dated April 4th.

7,005. "An improved electric accumulator plate." R. F. YORKE. Dated April 5th.

7,020. "Improvements in the construction of electro-magnets and in their application to electromotors and apparatus for use with alternating currents." J. A. KINGDON. Dated April 5th.

7,069. "A new method of fitting telephone instruments." A. E. FIELD. Dated April 6th.

7,082. "Improvements in flexible brackets for electric lighting and other purposes." F. W. KETLEY. Dated April 6th.

7,085. "Improved apparatus for producing intermittent electric flash light signals or messages by the Morse or kindred codes." O. E. WHEELER. Dated April 6th.

7,101. "Improvements in apparatus for use in connection with electrical transformers." F. H. MEDHURST and W. J. HOPE-JOHNSTONE. Dated April 6th.

7,190. "Improvements in the manufacture of the magnetic parts of electrical apparatus." A. G. NEW. Dated April 7th.

7,192. "Improvements in guards for electric and other lamps." J. EATON-SHORE. Dated April 7th.

7,194. "Improvements in vehicles running on rails, applicable to electric traction and for other purposes, and adapted to pass around curves." G. AVERLY. Dated April 7th.

7,199. "Improvements in portable electric lamp apparatus." S. HELLEBRANDT. Dated April 7th.

7,213. "Improvements in the manufacture of concentric electric conductors." J. S. RAWORTH and T. O. CALLENDER. Dated April 7th.

7,246. "Improvements in material for conveying electrical currents to the human body." H. NEHMER. Dated April 8th.

7,266. "Improvements in the distribution of electrical energy." J. WHITCHER. Dated April 8th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

7,278. "Improvements in electric switches and circuit-closing and opening devices." G. PERCIVAL. Dated April 28th. Consists in the use of inclined surfaces and non-inclined surfaces arranged so as to come into action one after the other conjointly with contact-piece brushes or surfaces adapted to the said inclined or non-inclined surfaces, and capable of moving relatively to them, and of various means of imparting such motion, and in some cases of the arranging of the various parts of the device that necessary contact between the moving and the fixed surfaces is maintained by the action of gravity or gravity in conjunction with springs. 7 claims.

12,703. "Improvements in or connected with switchboards for electrical purposes." T. HAWKINS and F. M. NEWTON. Dated July 27th. The inventors support the switchboard by means of suitable hinges, which are attached on one side of the hinged joint to the switchboard itself, and on the other to a suitable support of any convenient kind, such, for example, as one fixed against or built into a wall or partition, or as a standard of suitable construction which may be bolted to the floor or supported in any other convenient manner. In this case the switchboard is hung somewhat after the manner of a gate on gate post. 4 claims.

12,934. "An electrical parcel exchange system." A. R. BENNETT. Dated July 30th. The inventor lays lengths of tunnels along the street, road or route best calculated to secure suitable admission to the buildings participating in the parcel exchange service. The tunnel may contain two tracks or lines of rails, or an up and down track may be contained in separate tunnels. In the first case the tracks may be laid not on the bottom of the tunnel but on bridges preferably of insulating material placed at proper intervals, so that a clear space would remain below the tracks in which could be laid the necessary electrical conductors, wires, &c., and which space would also be available for the laying of electric light conductors, telegraph and telephone wires, gas and other pipes not necessarily connected with the parcel exchange system. 2 claims.

13,125. "Improvements in carbon-holders and screens suitable for electric welding." H. HOWARD. Dated August 1st. Claims:—1. In carbon holders the combination of a support for the carbon, a screen of coloured glass carried by the support, and an opaque bar interposed between the carbon and the screen. 2. In carbon-holders the combination of a tube, a cap screwing on to one end of the tube, a split clip embracing the carbon and forced into the other end of the tube, a cone within the cap, and adapted when the cap is screwed on to force the wires of the conductor into close contact with the tube. 3. Apparatus substantially as described and shown in the drawings.

13,280. "Improvements in electrical conduits and means for connecting conductors in the same." J. M. M. MUNRO. Dated August 6th. The conduits are preferably pipes of fire-clay or similar material of suitable strength and glaze. Drawing-in boxes are provided at suitable distances, usually about 150 feet apart. These boxes may be made of fire-clay brick and cement, or iron or other material. Within the fire-clay pipe are placed insulating discs or supports, preferably of earthenware having holes or grooves to carry the conductors. The conductors are drawn through or into the holes or grooves in the insulating discs and terminate in the drawing-in boxes. The conductor in one length of the fire-clay pipe is connected with the corresponding conductor in the succeeding length of the fire-clay pipe by means of a tightening-up arrangement. 3 claims.

13,331. "Improvements in telephony and apparatus therefor." M. G. KELLOGG. Dated August 6th. Relates to metallic circuit telephone exchange systems, and especially to multiple switchboard systems. It relates especially to clearing out signal receiving apparatus for such systems, and to calling apparatus which may be operated in connection with said clearing out signal receiving apparatus. 8 claims.

14,040 "Improvements in electric lighting and extinguishing apparatus for gas burners." H. H. LAKE. (Communicated from abroad by A. Örling, of Stockholm.) Dated August 19th. Comprises an arrangement of the lighting and extinguishing apparatus in which the apparatus ceases to work when the gas is lit or extinguished, even though the pressure upon a contact button is continued and at the contact button there is a signalling apparatus for indicating whether the last operation of the apparatus has caused the lighting or the

14,817. "Improvements in and connected with electric tram-cars." W. E. HEYS. (Communicated from abroad by C. Brown, of Paris.) Dated September 2nd. Consists in the application of a system of four bearing trucks and motors to an automobile vehicle, the said trucks being articulated and perfectly independent of each other. 4 claims.

15,768. "Improvements in the method of and apparatus for distributing Electricity." C. J. HALL. Dated September 17th. Consists in arranging the engine to drive two dynamos of approximately equal capacity, say A and C. A is an alternating current dynamo, and C is a continuous current dynamo. A, say, is equal to 100 units in capacity, and absorbs the whole power of the engine when at full load; as the outside demand falls off, the balance of the power of the engine is taken up by the dynamo C, and its energy is stored in a battery of accumulators. C also acts as exciter to A. 3 claims.

15,377. "An improved electric globe gallery and shade holder." J. WHITEHEAD. Dated September 11th. Inside the metal coronet, which usually forms the ornament or cover for the top of an electric globe, is first fixed by soldering, riveting, or otherwise, a plain or perforated metal plate or disc, or any other suitable arrangement, upon a rim, flange, or bearing inside the coronet, and about half an inch from the bottom edge; then upon this disc or plate is fixed by riveting or otherwise, so as to turn as on a pivot or joint, one, two, or three, or more quadrants, which are toothed as a cog wheel; attached to each of these quadrants is a projecting arm, bent in such a manner, as to enter the inner part of the top of the electric globe. The extending of these arms will then be actuated by a cog wheel, fixed in the centre of the plate or disc, to work upon and rotate the toothed quadrants, the teeth in the wheel and quadrants being of corresponding size, so that the movement of the centre wheel will cause the arms of the quadrants to close in or extend according to whichever direction the centre wheel is turned; therefore, when the quadrant arms are brought close together, they may then be easily passed through the mouth of the globe, and by the reverse movement, the arms of the quadrants will extend so as to press against the inner part, side or flange of the globe, and so hold it in a vertical or other position. 1 claim.

15,872. "Improvements connected with electric motors and elevators." AMERICAN ELEVATOR COMPANY. (A communication from abroad by Otis Bros. & Co., of New York.) Dated September 18th. Has for its object to overcome some of the difficulties or bad effects experienced in starting the motor with its load, and to prevent the accidental displacement of the switching apparatus, and to provide means whereby the operator in the cage may be sure that the switch is in proper position, so that the apparatus can be left with safety. 12 claims.

16,091. "Improvements in electric circuits for lighting and other purposes." W. H. MASSEY. Dated September 22nd. The two end switches are such that they can connect the line wire to one or other of two branch wires leading to the next switch, and each of the intermediate switches are such that they connect the ends of the two branch wires from the preceding switch, each with one or other of the ends of the two branch wires leading to the next switch. 4 claims.

16,113. "Improvements in suspenders or hangers for electric lamps, applicable also for other articles." T. H. O'BRIEN and C. O'BRIEN. Dated September 22nd. The inventors provide a drum or cylinder round which is wound and to which is attached the wire, cord or chain by which the article is suspended. This drum is actuated by a spring preferably placed in a cavity inside it. One end of the spring is attached to the drum or cylinder and the other to a spindle round which the drum rotates or to a fixed pivot or support. The spindle of the drum is stationary, one or both ends being fixed to the supporting bracket. On one end of the spindle is fixed a notched disc or plate provided with notches in its periphery, and on the end of the drum or cylinder are fixed a number of pawls or catches which fit the notches in the plate. The form of these pawls is such that when passing quickly over the notches in the plate they will not drop in, but when stopped or moving slowly, they drop into one of the notches and arrest the backward movement of the drum. 2 claims.

16,300. "Improvements relating to electrical fittings." C. S. SNELL and WOODHOUSE AND RAWSON UNITED, LTD. Dated September 25th. The inventors make use of a base of any suitable insulating material, more or less fire and water proof, and capable of being readily moulded, such as all kinds of ceramic ware or equivalent thereto, and they so form it, that the terminal or contact plates, or similar fittings, are held in position as regards vertical movement by projecting lugs, and horizontal movement is prevented by the shanks of the screws in the metal work used for attaching the leads or the like. 7 claims.

16,641. "An improved coupling for lightning conductors." J. LEWIS. Dated September 30th. The coupling, instead of being made in two pieces as heretofore, is made in a single piece (approximately of link or stirrup form), and having sockets at its upper and

lower parts, the former being cylindrical, and screw threaded for attachment of the top rod, while the latter is so flattened and of dovetail or wedge shape for retaining the tape which is secured to the coupling by passing it through the socket, and out laterally, and then doubling the end of the tape on itself, so that when the tape is drawn back its end is jammed in the socket, and it is effectually prevented from becoming detached; the strain on the tape assists materially in maintaining good contact. 2 claims.

CORRESPONDENCE.

Dry Battery Tests.

In reply to the remarks made by your correspondent, Mr. H. Lewis Jones, upon the comparative tests of Hellesen's and E.C.C. dry batteries, we wish to make the following observations:—

The main features of the tests made by Prof. Jamieson may be summarised as follows:—

	E.C.C.	Hellesen.	Superiority of the E.C.C.
Initial E.M.F. ...	1·455 volts	1·430 volts	...
E.M.F. after short-circuit, rest, and final short-circuit of 23 hours ...	0·597 volts	0·167 volts	250 per cent.
Ampère-hours while short-circuited for 54 minutes ...	2·18 amp.-hrs.	0·95 hours	135 per cent.
Total output in watts, discharging for a period of 72 hours	11·93 watt-hrs.	3·18 watt-hrs.	275 per cent.
Electric bell ringing tests ...	88 hours	33 hours	160 per cent.

The output in watt-hours, E.M.F., and durability of the E.C.C. dry battery is, therefore, on an average, 200 per cent. better than that of any other dry battery.

Assuming, now, as your correspondent remarks with some justice, that the E.C.C. dry cell were the heavier of the two—that the difference of weight and size between the two cells is 20 per cent.—it still follows that the E.C.C. cell shows a balance of more than 100 per cent. of superiority as against the Hellesen.

We agree with your correspondent that a most important test to judge the value of a dry cell is the one bearing upon durability; but on this score, too, we have made a number of tests, and can affirm that the E.C.C. dry cell is fully as good as any other dry cell on the market.

As your correspondent appears to have had experience of an opposite kind, we can only imagine that some unaccountable short-circuit must have happened to his E.C.C. cells, and we are therefore willing to replace the same to him by new cells free of charge, provided he will subject them to exactly the same protection as the Hellesen cells in each case; and we have every confidence that he will find them not only superior as to output, but certainly equal as to durability.

The General Electric Company, Limited.
Max Binswanger, *Director.*

London, *April* 17*th*, 1893.

Large Wattmeters.

Your issue of the 14th inst. contained a short description of a wattmeter capable of registering 800,000 watts, manufactured by the Société des Metaux, Paris. It may, perhaps, interest some of your readers to know that we have recently executed an order from the City of London Electric Lighting Company, Limited, for a meter registering up to 2,000,000 watts. This is, as far as we know, the largest recording wattmeter in existence, and is of the type designed by Prof. Elihu Thomson. The shunt coil is fed by a transformer, which reduces the difference of potential from 2,000 volts to 50 volts. It is in almost all respects similar to the ordinary stock size, but, owing to the large ampère capacity, it has been considered advisable to put the series terminals outside the case.

Another interesting feature is, that during some recent exhaustive tests made on this meter prior to its delivery, it was demonstrated conclusively that its constant was substantially the same with continuous and alternating currents, so that the Brillié meter referred to in your issue, although having a larger ampère capacity, is much smaller as a wattmeter. A similar meter to the Thomson, referred to above, but having a capacity of 300,000 watts, has been in use in the City of London Company's Wool Quay Station for some months, and has enabled them to ascertain exactly the output of the station from the date of its installation there, by furnishing reliable data on which to base calculations as to commercial efficiencies, &c. The value of these data depends, of course, on the ability of the wattmeter which is used on the primary mains feeding the transformer sub-stations to register true watts; and, with a view to ascertaining whether it did so or not, it was carefully tested, first, by comparing its reading with those of a Siemens dynamometer wattmeter on circuits of different impedances. The potential across the terminals of the fine wire coil of the indicating wattmeter being reduced by means of a variable non-inductive resistance, as described in Dr. Fleming's recent paper before the Society of Arts; and, secondly, with those of a Lord Kelvin wattmeter, the current for the fine wire coil being passed through a non-inductive resistance in series with a specially-constructed Cardew voltmeter, the indications of which at any moment were equivalent to inspectional ampère-readings of the shunt current; the current values of any given deflections having been previously ascertained by means of an ordinary Kelvin deci-ampère balance, and plotted in a curve.

The Laing, Wharton and Down Construction Syndicate, Limited.
James Devonshire.

London, *April* 17*th*, 1893.

Train Lighting.

I notice in your issue of the 7th inst. a letter headed as above, which appears to call for some little comment.

Passing over the whole of the first part of this communication, which, by the way, has no reference to "train lighting," I arrive at the concluding paragraph, which, to say the least, is decidedly misleading, and calculated to defeat the very object for which the letter purports to have been written, namely, to point out the fact that the Midland Railway Company were not by any means the first in the field in the question of train lighting.

It would have been far more consistent had your correspondent mentioned the *only two successful* systems of train lighting, viz., those *regularly in use* on the Brighton and Great Northern Railways, and have left out others which have proved unsuccessful, especially as one of these (the Brighton) was in use long before either the North British, the Lancashire and Yorkshire, or, in fact, any other company thought about trying it.

As to the financial side of the question, I do not think that the spasmodic attempts made by the North British or the L. & Y. can possibly prove anything either one way or the other, especially as the systems employed in both these instances were perfectly unworkable, according to the opinions expressed by most railway engineers who have given any attention to the subject. Neither do I think that the Midland experiments have been carried far enough at present to justify the conclusion that train lighting by electricity is a financial failure, especially in view of the fact that two companies *are working* practically the same system with *marked success and economy.*

Since writing the above, which was too late for last week's issue, I find Mr. Langdon has very ably taken up the cudgels in his own behalf, and has succeeded in showing that, whatever other companies have done or are doing, the Midland are certainly not behindhand in general electric lighting.

F. W. Cooke, M.I.E.E.

Great Northern Railway, Retford,
April 17*th*, 1893.